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MORE SUBWAY WEATHER.

At the present writing the great city of New York is being swept by a very respectable blizzard. The snow is falling rapidly, and is being whirled through the streets and piled wherever a building offers a partial barrier to the gale. Surface electric lines are struggling gallantly to keep the cars moving. The sweepers are out in full force, and they are being assisted by cars coupled behind. The cars themselves are running in twos, and are still able to maintain some sort of service. The elevated roads are perhaps suffering less, since the high wind keeps the structure fairly free from snow, but the dense clouds of flying snow interfere greatly with the view ahead, and necessarily upset the schedule.

A great contrast to these conditions on the street and overhead is the state of affairs in the subway, where the trains are running merrily along, indifferent to both wind and snow. The view along the track is as clear as on the brightest sunny day, the only difference in conditions being possibly the increased number of passengers at the stations, as many naturally wish to take the most comfortable way of getting through the city. The only fault one may find with the subway at the present time is that there is not more of it, but this, it is hoped, will be remedied as time permits. A day like the present one makes one wish that the elevated roads could be enclosed, and thus made fairly independent of storms.

ACETYLENE GAS LIGHTING IN FRANCE.

An interesting summary of the use of calcium carbide for illumination in France is given in *Engineering* (London), for January 6. When it was first shown that it was possible to produce acetylene commercially it was thought that it would supersede in many places both illuminating gas and electric lighting.

Although the production of acetylene took an important place in France in 1896, many disastrous accidents seriously checked its use. This resulted in the taking out of a large number of patents dealing with the production and utilization of acetylene, and finally the government stepped in with certain regulations aimed to diminish the risk caused by the use of this illuminant. When the receiver for the gas did not exceed in capacity 1,000 litres it could be placed in close proximity to dwelling-houses, after obtaining due authority from the municipal government; but when its capacity was greater than this, it was necessary to consider other property, and such receivers were not allowed in any place where an objection might be raised to them. These restrictions, however, were not prohibitive. It is said that there are now 40,000 installations in use in France, five-sixths of which have never been authorized. The insurance companies at first enforced stringent regulations where acetylene was used, but more recently they have modified these and charge no additional premium, provided the gas producers and the supply of carbide are not within the building.

There are 112 towns in France now lighted by acetylene. The consumption of carbide was 4,500 tons in 1898. It has since increased annually until in 1902-1903 the consumption was 14,500 tons. No later figures are available. The pipes used are generally of lead. Some early work of laying these was very unsatisfactory, as the contractors did not appreciate the conditions which should be fulfilled for an installation of this character. The towns using acetylene for street lighting are, as a general rule, small, the population not exceeding 5,000 inhabitants. Street lamps are placed from fifty to sixty metres apart, and usually contain but one burner. The price charged varies in different towns.

Recently one has heard but little about the production and use of acetylene in Europe, and from the conditions frequently

reported a year or so ago, one has been rather led to believe that it is used but little. This is probably because we heard only of those cases where a failure occurred. The successful manufacturing companies and those towns where the lighting was satisfactory attracted no attention. There is some satisfaction in knowing that this new illuminant is being used with success, and is apparently growing in popularity. It is evident that its proper field—that of illuminating small towns—is being recognized.

COMPOUNDING ALTERNATORS.

The regulation of alternators so as to maintain a steady voltage on the system is one of the most important problems in the design of these machines themselves, and in the operation of a station. There are a number of ways of doing this, which are more or less satisfactory. The oldest plan, once satisfactory for small systems, was to vary the intensity of the exciting current by means of a rheostat adjusted by hand. This arrangement has been modified by adding an automatic regulator, which adjusts the exciting current as conditions require. Some of these devices are quite simple and give excellent regulation.

Another method of compounding alternators, frequently called "compensating," consists in sending through auxiliary windings on the field the whole or a portion of the armature current previously rectified. While this arrangement takes care of changes in load, provided the power-factor does not change, it does not regulate for varying power-factors. Moreover, it increases the size and the cost of the machine. The latter objection has been avoided somewhat by compounding the exciter, and if this be done in one of several ways, compensation for a change in power-factor is secured at the same time. By modifying the method of applying the rectified current to the alternator fields themselves, it is possible to obtain a regulation for varying power-factors, and this has been done by Heyland and Latour.

All of these methods operate by changing the magnetization of the field-magnet, and hence are not instantaneous in their action, because it requires some time to effect a change in the magnetization of the fields. To avoid this, a method of compensation by means of the armature currents is described in a paper read recently by Mr. Miles Walker, before the Manchester section of the Institution of Electrical Engineers, of Great Britain. The theory of the action of this method is simple, and is said to be effective in use. Its principle lies in the splitting up of the alternator pole into two parts. One of these forms the main field-pole, and is surrounded by the main field-coil. The design is such that this pole is always saturated. Projecting from this pole is an auxiliary pole surrounded by an auxiliary coil which is placed around the two sections of the pole. This auxiliary coil may or may not be used, as conditions require. Assuming it not to be in use, the operation is as follows: the current through the main exciting coil sets up such a flux in the armature as to give the no-load voltage, and, as stated above, produces saturation of this pole. If, then, a current be drawn from the armature, its magnetizing effect tends to produce cross-magnetization of the pole. The arrangement of the two poles and the direction of the rotation are such that this cross-magnetization acts in opposition to the magnetization of the main pole, and hence tends to weaken it, while it magnetizes the auxiliary pole in the same sense as the main pole. The weakening effect on the main pole is negligible, because the latter is saturated; hence the total effect of the armature action is to produce an increased flux through the machine. With a proper proportioning of the main auxiliary poles, this increased flux would be just sufficient to maintain the voltage of the machine constant. This arrangement compensates only for change in load, since for a given current the effect is diminished by a lagging power-factor, and increased by a leading one.

The function of the auxiliary coil is to give the operator control of the compounding effect, for by producing a part of the initial magnetization in the auxiliary pole by means of its coil, the susceptibility of this pole to the armature reaction can be controlled; hence the same machine may be adjusted for flat or any degree of over-compounding. As an instance of this, the following test was given of a 150-kilowatt, three-phase generator. The voltage for no load was set at 416, the field current of the main coils remaining constant. The power-factor was practically unity. Upon throwing full load upon this machine, the voltage rose to 445, showing an over-compounding of six per cent. By diminishing the main current and bringing the voltage up to normal by the auxiliary current, it was possible to adjust the machine to hold its voltage exactly between the load and the full load.

The objection to this method of compensating is that the compounding effect decreases with a decreasing power-factor, but it is held that this objection is not serious under ordinary conditions, for, as a general thing, during the day a generator has to supply the magnetizing currents to transformers. This is chiefly inductive. As the load comes on at night, the power-factor also increases. This is a neat solution of the compensating problem, and has the advantage that its effect is instantaneous. It does, however, increase the size and complexity of the field, and hence must increase the cost. The method is pretty as it uses a disturbing influence to effect the compensation. The armature reaction instead of causing a fall in potential is made to increase it.

THE ELECTRICAL INDUSTRY AND ITS RELATION TO THE MINERAL INDUSTRY.

It is always interesting to notice how intimately electrical methods are interwoven with all our industries. One can not but be impressed with this when examining the reports of any industry, if he is at all interested in following the spread of electrical methods in other industries, and in seeing how the needs of the electrical industry give rise to new industries. For instance, one at first thought would be of the opinion that a report upon the mineral resources of the United States would have but little to attract the attention of electrical men. On the other hand, a great deal of interest may be found in the report which the United States Geological Survey, Department of the

Interior, Washington, D. C., has recently issued upon the mineral resources of the United States, covering the calendar year 1903. When examining this report one realizes how intimately the mining industries, the metallurgical industries and others are related to the electrical industry.

Among the minerals important in the electrical industry are, primarily, copper and coal. On the other hand, copper producers are dependent chiefly upon electrical consumers for their output. This is shown significantly by the rapid increase in the production of copper as the telephone, electric light, electric traction and, finally, electric transmission of power were introduced. Previous to the introduction of the telephone, the telegraph was the only electrical application, and this consumed but little copper, since the wires used for transmitting messages were chiefly iron. In fact, for a number of years after the telephone was introduced iron wires were universally used. The copper employed in these industries was chiefly in the manufacture of instruments. When electric lighting came in, the demand for copper caused a marked increase in its production to take place. Thus, the total output of the country in 1876 was about 19,000 long tons. In 1879 it was 23,000 long tons. In 1881 it was 32,000 tons. As electric lighting spread the consumption of copper increased until in 1887 it was 81,000 tons. In the following year it jumped to 101,000 tons. This is the date usually given as the beginning of electric railroading. During the nineties the increase in the output of copper was rapid, and in 1903 it had reached 311,627 tons.

Coal, being necessarily our chief reliance for power production, is vitally important electrically, but, taken as a whole, the consumption of coal in electric power stations is comparatively small. The total consumption of coal for the year 1903 was approximately 1,000,000 short tons per day. As the latest statistics for water power developed in this country show that this was only 438,472 horse-power (this being for the year 1902), it is apparent that while hydraulic development is of vital importance in the production of cheap electric power, this development will not have much effect upon the consumption of coal in this country. It should be borne in mind here that this enormous consumption of coal does not by any means represent the total fuel used in the country, for there were produced during the year in addition over 100,000,000 barrels of petroleum, and nearly 6,000,000 tons of natural gas. Assuming that all this fuel had been used for the production of power, and estimating the average consumption of six pounds per horse-power-hour and the average time of the running, fourteen hours per day, the power produced would have been 26,000,000 horse-power. This may be compared with the 438,472 horse-power made available, but not all used, by water-power stations.

Another metal particularly of interest to the electrician is aluminum, because this is produced entirely by electrical means and is nearly all used in the electrical trades.

Other metals more or less used for electrical purposes are zinc, which finds a small use in batteries and a large use in the manufacture of alloys which are indispensable for the manufacture of electrical apparatus of all kinds; lead, used as a protection for electrical conductors and in the manufacture of storage batteries; nickel, and antimony. Among the minerals are manganese, manganese ores, monazite and zircon, which are the sources of the rare earth oxides used in the manufacture of the Nernst lamp glowers.

Under the heading of clay-working industries we find that about ninety-four per cent of their value for the year represented porcelain electrical supplies, these amounting to nearly $1,500,000. This, it will be remembered, does not include glass insulators.

Carborundum production is another of the new industries depending entirely upon electricity. The production of this material for the year was not much less than that of the natural material, corundum. The latter abrasive is now made in the electric furnace, but none of the artificial corundum was on the market in 1903.

These do not represent all of the mineral industries which are at all related to the electrical industries, but the more important ones have been mentioned. This brief summary of this interesting and valuable report indicates how widely the new power is being used both as a means of producing these materials and as a consumer. In almost all of the industries covered in the report we could find some electrical interest—sometimes commercially; at other times merely of scientific value. Is this not an excellent object lesson of the widespreading electrical influence? Who twenty-five years ago could have imagined such unforeseen development of what was at that time mainly of scientific interest, with but one exception—the telegraph.

THE FIXATION OF NITROGEN.

An improved method of fixing atmospheric nitrogen has been announced by the Siemens & Halske Company, of Berlin. This process is the result of work with the so-called cyanamide process, but it seems to be a distinct advance over the latter. The cyanamide process is one in which the nitrogen in the air is fixed by passing air over calcium carbide. It is said that the resulting compound, which is calcium cyanamide, may be used directly as a fertilizer, and moreover, it contains lime as well as nitrogen. It has been used, experimentally at least, with considerable success at certain agricultural experiment stations.

The new process differs from the other by eliminating one step. Instead of making calcium carbide and then passing over this a stream of air, the air is passed over the mixture of lime and carbon itself, while the latter is being heated in an electric furnace. The process is thus a direct one, and not secondary. There are now several processes by which atmospheric nitrogen may be fixed, and as soon as the cost of doing this has been reduced sufficiently we may expect to see artificial fertilizer take an important position as an article of commerce. A large item in the production is the electric power necessary for carrying on the processes which have so far been devised.

DEVELOPMENTS IN ELECTRIC TRACTION.

NEW YORK RAILROAD CLUB DISCUSSES AN IMPORTANT PAPER.

At a meeting of the New York Railroad Club, held January 20, 1905, Mr. W. B. Potter presented a paper entitled, "Developments in Electric Traction." An abstract of the paper is as follows:

The recent advances made in electric traction have made it possible to deal with many classes of traffic which would not have been considered a few years ago; and, although we recognize that there are still many long-distance lines handling a certain description of traffic which is unfavorable to electric haulage, these cases are being reduced each year by the progress of invention, and also by the changes which are taking place in traffic conditions. By this is meant that the passenger service on many lines which was of a concentrated nature a few years back is now becoming more distributed, and is, therefore, favorable to the installation of an electric system.

Electric traction is peculiarly adapted to suburban and interurban railways and the general increase in this class of traffic has been enormous since the inauguration of electric service. The ultimate profits to be derived from any new traction scheme, whether steam or electric, must of necessity depend upon the resulting effect on traffic. This is, in many cases, a more or less unknown quantity when the proposition of electrification is first considered; but both history and experience have proved that in the past the amount of traffic has increased approximately in proportion to the facilities given the public and that it is quite possible to create a new traffic, as well as to provide for that already existing.

For this reason, in considering the electrification of a steam system as a whole, or the electrification of its branch or suburban lines, it is not sufficient to obtain figures showing the likely profits to be derived from such an undertaking merely by compiling data showing the cost of installation and the traffic receipts based upon the number of passengers traveling at that time. A margin may be allowed in favor of electrification due to the extra traffic that the increased facilities are practically sure to induce. The most profitable method of handling a distributed passenger service is by running many short or long trains, as the case may be, at frequent intervals, whereas with steam locomotives it is the general practice to deal with the traffic with only long trains capable of conveying a very large number of people at one time. I draw your attention to this fact, as it shows very forcibly that in a great number of instances where the traffic is of a concentrated nature at the present time, and, therefore, considered as unfitted for being handled electrically, were an electric system installed the traffic would naturally change from the concentrated to the distributed form.

Electricity has been considered for traction in many different ways; but broadly speaking, these may be divided under two main headings—direct-current and alternating-current systems. It has become common practice to style a system as either direct current or alternating current, according to the type of motors used on the car.

The direct-current system, with a central station feeding numerous rotary converters through the medium of three-phase high-tension transmission lines, which in turn supply an overhead trolley network with direct current at a pressure of from 550 to 600 volts, is without doubt the most highly developed and best known system in this country.

The alternating-current system may either employ single or three-phase generators and transformers. Both the generators and transformers will be three-phase where three-phase induction motors are used on the cars; and in such cases the line is equipped with two overhead trolley lines and the track rails serve as the third conductor. When single-phase motors are used on the cars, either three-phase or single-phase generators and transformers may be used, the choice being dependent on local conditions.

Three-phase systems have been extensively used in Europe, especially in Switzerland, Italy and Germany. The three-phase induction motor is particularly well adapted for service in which it is desired to control the speed of the car by means of the motors on down grades, either for the purpose of returning energy to the line or as a measure of safety.

The single-phase alternating-current system possesses two features which recommend its use: economy of trolley copper, due to the higher trolley voltages, and the elimination of the rotary converter. The chief advantage gained by these features is a saving in the initial cost of equipment: factors which increase in importance in proportion to the amount of power required by each car or train and with the length of the trolley line. The relative cost of any alternating-current or direct-current system will be materially affected by the number of cars employed. The saving in power resulting from the elimination of the rotaries is about offset by the greater weight and slightly lower efficiency of the alternating-current motor.

The efficiency of the alternating-current control, during acceleration, will, generally speaking, be somewhat higher than that of the direct-current system with series parallel control. With the alternating-current system fractional voltages can be obtained from the transformer on the car. Each step of the alternating-current controller gives a running position which corresponds with the series and parallel positions in a direct-current controller.

The potential of the transmission lines from the power station may be selected, as in the case of the direct-current system, without reference to the trolley or secondary voltage. The trolley voltage must, however, be considered from a different basis than that of the direct-current systems for the reason that in addition to the ohmic resistance of the trolley and track circuit there is an apparent increase in resistance, due to the alternating current. This increase in apparent resistance for twenty-five-cycle alternating current, as compared to direct current, is about fifty per cent in the trolley wire and between six and seven times greater in the rail return. The rails being steel, the increase in apparent resistance is relatively much greater than in the trolley wire. As the resistance of the track return with large steel rails is proportionately much less than that of the trolley wire, the apparent increase in resistance for the latter and the track taken together will be, roughly, from one-half to twice that for direct current. An alternating current at 1,000 volts is, therefore, about equivalent to 600 volts direct current so far as affecting the amount of trolley copper, and to secure the advantages of the alternating-current system to a reasonable degree at least 3,000 volts or, for heavier service, perhaps 5,000 volts must be employed.

The design of an alternating-current motor as regards length of air-gap and armature speed is affected by the lower average flux density. For this reason an alternating-current motor is larger and heavier than a direct-current unit of the same output.

The equipment of heavy locomotives with alternating-current motors for high-speed passenger service is a possibility, but owing to the limitations imposed by the space available for the motors, it

seems probable that two locomotives, each with four motors, would be required for service which could be performed by a single direct-current locomotive with four gearless motors. For locomotives in slow-speed work—such as freight or shifting—a double-gear reduction will, in many cases, be required, owing to the difficulty of winding an alternating-current motor of large size for slow speeds.

It is admitted that the first cost of equipping a railroad electrically is higher than the initial outlay for equipping the same road with steam locomotives; but it is well-nigh impossible to make a general comparative statement as to the relative first cost. This will depend on the number of locomotives required to handle the traffic in the one case and in the other upon the density of the traffic, and it is the latter factor upon which the size of the generating station and transmission lines are dependent.

For example, assume a suburban train of four cars hauled by a steam locomotive, and a similar train operated by electric motors under the cars:

Tests on a steam locomotive in this class of service have shown, approximately, 0.07 indicated horse-power-hour per ton-mile and a coal consumption of 6.86 pounds per indicated horse-power-hour. Assuming coal at $2.50 per ton, the cost of coal per train-mile is 14.5 cents.

The cost of electric power per kilowatt-hour is well established by records from many power stations. As the cost of coal and labor is a variable quantity we will assume $0.006 as a basis. The labor and maintenance of substations may be taken as ten per cent additional, making a total cost per kilowatt-hour of $0.0066. The efficiency of transmission and substations may be taken as seventy-eight per cent. The cost of power for the electric train per train-mile would be 10.3 cents.

The wages per day for a train crew in steam service may be taken as twelve dollars. The crew for the electric train will be the same, omitting the fireman. In steam service this crew will make a train-mileage of, approximately, 100 miles per day. In an electric service, due to its greater flexibility, it is a reasonable assumption that the crew will make a mileage of 150 miles per day.

Under this assumption the wages per train-mile will be: steam, twelve cents; electric, 6.7 cents.

The maintenance of steam locomotives varies, but in this class of service 6.5 cents per locomotive-mile seems a fair basis from the records available. The maintenance of the electrical equipment per car-mile on the Manhattan is $0.025, and as these equipments are larger, we will assume one cent per car or four cents per train-mile.

A summary of the comparative cost per train-mile is as follows: steam, 34 cents; electric, 21.2 cents.

Assuming a yearly mileage of 50,000 miles, which is a reasonable assumption for the electric train, the yearly difference in cost of operation, in favor of electricity, would amount to $6,400, representing an interest on the total investment per train which would be more than sufficient for that usually required for the car equipment and the proportionate part of the power station and transmission. Furthermore, to this capitalized investment should be credited the cost of a steam locomotive equipment capable of making 50,000 miles per year.

The statistics covering the steam and electric operation of the Manhattan Elevated[1] shows an increase in traffic and a lower cost of operation per car-mile, resulting from electrical equipment. The probable increase in traffic was not sufficiently recognized, prior to the electrical equipment, as to be reckoned an important factor in the earnings of the road, but its influence to this end will be better appreciated when it is remembered that during the latter period of steam service the number of passengers carried decreased each year.

Careful calculations should be made, on each individual road considering electrification, as actual results will vary with every new set of conditions. The point at issue is whether the traffic is, or is likely to be, of such a character that the saving in operation or increased receipts will show a proper return upon the required capital.

In considering the application of electric power to freight service, the subject may be considered more strictly from the standpoint of existing traffic, as the reasons which influence the growth of passenger traffic will apply only in so far as the movement of freight may be facilitated and cheapened. Electric power in a single unit, such as locomotive, is best suited for general freight, although there may be special cases where it will be advantageous to equip several or all of the cars in a train and control from the leading car.

As with the steam locomotive, the design of the electric locomotive is influenced by the service for which it is to be used.

[1] See ELECTRICAL REVIEW, November 26, 1904.

The bogie truck type following the precedent of the motor-car was the first to come into general use and it has become a well-established type for general service in high-speed haulage, or for yard shifting where there are many curves. The articulated type is well represented by the locomotives originally supplied to the Baltimore & Ohio Railroad for the Baltimore tunnel. This type is much the same as two coupled locomotives with the disadvantage of not being two independent units, either of which can be operated or repaired independently of the other. The rigid frame type is one in which all axles are held square with the frame and parallel to one another. The mechanical design is strong and simple and well adapted for heavy slow-speed haulage. The additional equipments for the Baltimore & Ohio Railroad tunnel are of this type.

The requirements of high-speed passenger service are especially severe, demanding a locomotive of large power and consequently of heavy weight, as well as one possessing a reasonably flexible wheel-base.

The locomotive recently designed and built by the General Electric Company and the American Locomotive Company for the New York Central Railroad is the result of a careful study of many different types. This electric locomotive differs from any that have previously been built, in having a rigid frame for the drivers and pony trucks at each end for guiding.

The method of conveying electric power to a car or train is influenced by the size of equipment and conditions under which it operates. The simple trolley and wheel in general use has been surprisingly satisfactory in service much more severe than that for which the trolley-wheel was originally considered. The limitation of its capacity is rather in the life of the wheel than from any particular difficulty in collecting the current. With cars of medium size, at moderate speed, an upward pressure of fifteen or twenty pounds against the trolley wire is sufficient and the life of the wheel is frequently 10,000 miles or over. At car speeds of fifty to sixty miles an hour an upward pressure of thirty-five to forty pounds appears necessary to ensure the wheel maintaining close contact with the wire over the irregularities of the suspension. This greater pressure, coupled with the larger amount of current commonly taken at such speeds, results in the rapid wearing of the trolley wheels.

Considerable attention is being given to the development of a collector for heavy

service which will cost less to maintain than the present trolley-wheel. The bow form of trolley, in which a sliding bar of copper or aluminum at right angles to the trolley wire replaces the trolley-wheel, has been used to some extent abroad and seems to have met with considerable favor. The cars on which the bow trolley has generally been used are of comparatively slow speed and power, and such tests as have been made indicate that in the equivalent of our suburban service the maintenance of the bow trolley would considerably exceed that of the trolley-wheel. A modification of the bow trolley in which a roller replaces the sliding bar has been used in a number of cases, with excellent results. Where the trolley wire is maintained within a foot or two of uniform height, a reversible trolley contact with a pantagraph mechanism, carrying a roller for contact with the wire, can readily be applied. Where the variation in height of the trolley wire is considerable, on different parts of the same line, the pantagraph construction must necessarily be of considerable size. It is customary to install two pantagraph trolleys, each collecting its share of the current and where necessary to collect a larger amount, as might be the case in locomotive work, additional trolley contacts may be installed to any extent required. A pantagraph type of trolley, provided with a shoe instead of a roller, is well adapted for use in connection with third-rail operation, where it is desired to make contact through special track work or road crossings where the third rail can not be conveniently installed.

The ordinary methods of trolley-wire suspension and insulation are not well adapted for high-potential alternating trolley lines, and what is known as a catenary suspension of the trolley wire will probably be more generally used. In the catenary suspension the supporting cable or catenary is carried over the top of high-potential insulators at the point of support and the trolley wire is attached by clips and hangers directly to the catenary without intervening insulation. The catenary thus serves as a supplemental conductor to the trolley wire and it may be of either steel or copper. As the trolley wire is supported at frequent intervals, the poles for the catenary can be spaced at longer distances than common with the ordinary type of trolley construction.

The third rail, although used to a considerable extent in place of the trolley, has been criticised, particularly from the standpoint of danger and trouble from sleet. The unprotected rail is open to both these objections, but with a suitable protection against accidental contact and from sleet, these objections are to a great extent overcome. A protection providing these features is in use on the Wilkesbarre & Hazleton Railway, New York subway and the one under construction for the New York Central.

The location of the third rail, with reference to the track, would seem to be a simple question, but owing to local conditions, nearly every installation has been different. Between clearing the low-pressure cylinders of compound locomotives, the hoppers on the large steel coal cars and keeping within the bridge abutments and tunnels, the location is generally a case of compromise. It will be advantageous to facilitate the interchange of equipments by establishing a uniform location of the third rail and the importance of such a standard and difficulty of finally determining it will increase with every new installation.

The subdivision of the third rail into sections which will be normally disconnected from the supply circuit and automatically connected when in the immediate vicinity of the car, has many times been proposed. Such an arrangement appears to have little or no advantage, as, apart from the complication introduced, the sectional third rail should be protected by a covering to the same degree as an ordinary third rail. Unless the sections are very short, the rail will be energized for some distance beyond the car, and persons getting on or off, or working about the car, would be likely to receive shocks, and more especially so as the rail would ordinarily be considered harmless. Another important reason for protecting the rail is that the cover will form a shield from sleet, which is much more troublesome on a sectional third rail than on the ordinary third rail.

The third-rail contact shoe, which has been quite generally used, depends on gravity for its contact with the rail; therefore, at high speeds with any unevenness on surface of the third rail this type of shoe shows a disposition to jump and arc excessively. A better form of shoe is one in which the contact is held against the third rail by a spring.

The initial expense of electrical equipment, more especially that due to the cost of power station and trolley line, has deterred many steam railroads from electrifying branch lines in sparsely populated districts. Such lines could be served more profitably by independent cars than by steam trains, as the possibility of economically operating single cars on frequent headway, by providing a better service, would have an important influence upon the development of the traffic.

To meet the requirements of this class of service, a self-propelled car, independent of any feeder system, seems particularly well suited. With this end in view there have been numerous schemes suggested and tried, some employing steam and others compressed air as a motive power; and again, storage batteries and gasoline engines have been used. Without discussing the relative merits of these different methods, it may be briefly stated that the gasoline engine seems to have the advantage of possessing the greatest power for a given weight, and is also able to cover considerable distances—owing to the concentrated nature of the fuel and the high efficiency of the engine in relatively small sizes.

The paper was illustrated by lantern slides. At its close President Vreeland announced that the meeting was open for discussion, and called on Mr. W. J. Wilgus, fifth vice-president of the New York Central & Hudson River Railroad.

Mr. Wilgus stated that the cost of equipment in electrifying a steam road is not the principal part of the expense. On the New York Central the cost of the equipment was about one-quarter of the total cost of electrification. Slow-speed traffic must be separated from high-speed. Grade crossings must be eliminated, and stations and platforms must all be rebuilt. The terminal must also be reconstructed. The increase of business due to the electrification and the consequent better service is looked upon to remunerate the company for the outlay. A steam road uses only part of the property rights. It does not utilize either the overhead or the underground rights, and can only expand sidewise, while an electric road can be used both overhead and in tunnels. With electric traction a great amount of switching is done away with, as multiple-unit cars can each switch themselves. Another item of expense on the New York Central which will be done away with by electric traction is the frequent cleaning of the Park avenue tunnel. This tunnel is now cleaned thoroughly every two weeks. The gases and noise from locomotives are an additional annoyance.

Mr. Frank J. Sprague said that the largest question in the electrification of steam roads is, will trunk lines be operated electrically, and will alternating current or direct current be used; also, will high

tension or low tension be used? He stated that it is possible to run trunk lines electrically with low voltage if the traffic is dense. The load on a substation is proportional to the distance between them, and increases as the distance between them increases, irrespective of the density of the traffic.

Mr. B. G. Lamme spoke of the increase in the size of motors being attended with an increase in voltage in stationary work. He called attention to the fact that there had been almost no increase in voltage in railway work. He does not believe that the third rail is suitable for freight service, and that the trolley must be placed either overhead or underground. If the voltage used on railway motors is increased, the overhead trolley can be retained. If direct current is used with low voltage and heavy service, 3,000 or 4,000 amperes would be necessary on the line, and this would be objectionable with overhead work. He thinks that the remedy will be to use high-tension alternating current with a small current, and considers that the single-phase system is the best; or a motor-generator might be used on the car with polyphase motors. He stated that a 15,000-volt trolley apparatus is now planned with a speed of ten miles per hour for freight service. Catenary suspension will be used for the trolley wire. He considers that motor-generator systems are not flexible enough for universal use on railways, but that the pure single-phase system is perfectly flexible and can be adapted to any service. High voltage can be used outside of the yards or on grades with alternating current, and it can be varied to suit conditions of speed. This can not be done with direct current. With alternating currents the voltage can be varied without opening the circuit, thus doing away with the complications incident to direct-current control.

Mr. B. J. Arnold stated that he was glad to hear Mr. Potter say that alternating-current railway motors were a success. He early thought that the direct-current system would not be able to put the steam locomotive out of business. He said there were three possible ways of using alternating current, namely: the series single-phase motor, the motor-generator used on the Ward Leonard system, and three-phase motors on the axles. The two latter systems were handicapped by requiring an excessive weight of locomotive. The single-phase series motor has been developed and seems to be the solution of the problem of electrifying steam lines. He believes that the elimination of grade crossings is absolutely essential, but is opposed to the use of the third rail. He discussed the reasons for the adoption of direct current on the New York Central, and stated that alternating-current motors for railway work were not sufficiently developed at the time the decision was made to warrant their adoption. Local conditions also required direct current. He agrees with Mr. Sprague that the density of traffic affects the application of electricity to trunk lines, and thinks it would not pay one road in a thousand in the United States to equip its system with direct current, but that it would pay nearly all to equip with alternating current. Roads will electrify their systems for passenger service, which will grow rapidly, and freight service will eventually be operated electrically, as it will be the smallest part of the business, and it will not pay to use two systems.

Mr. George Gibbs spoke of the difficulties of finding a form of rail or transmission to suit all classes of service. He is opposed to the building of cars which encroach more on the permanent way than do those in use at present, and spoke of the difficulty of installing a third rail so as to clear steel hopper cars and compound locomotives. On the later freight cars the truss rods are too close to the rails, so that no room is left for the third rail. He hopes that a thorough discussion of the proper position of the third rail will soon take place.

Mr. J. G. White favors putting the advantages and disadvantages of electrification of steam lines in separate columns, translating them into dollars and cents, and then adding up and finding which is the better. He spoke of the increase of traffic on electric lines, and the decrease of traffic on steam lines in the West. He favors the third rail, and described the difficulties experienced with the bow trolley in Holland. He stated that on the line recently constructed by his company there the cars were equipped with the bow trolley, and that at one time, while fifteen per cent of the equipment was in use on the line, every trolley was disabled.

Mr. Potter, in closing the discussion, stated that the third rail will do its work perfectly with proper protection from sleet and accidental contact, and that it will be quite permanent. He thinks that the Manhattan Elevated Railroad could be operated with a trolley, if necessary, at 600 volts, if two pantagraphic trolleys were placed on each car.

The Electrical Contractors' Association of Ohio.

The Electrical Contractors' Association of Ohio met in regular semi-annual session at Cleveland, Ohio, January 11, 1905. The occasion was a notable one on account of the number of representatives present from all parts of the state, together with the presence of large numbers of supply dealers and manufacturers, making the meeting by far the largest and most important of any hitherto attempted in the history of electrical work in Ohio.

The pleasure of the occasion was enhanced by the presence of the Buckeye Club, which is composed of the electrical supply dealers in Ohio, Indiana, and cities bordering thereon. The contractors' association after transacting its business entertained as guests the members of this coterie at an elaborate banquet.

The report of the state secretary showed considerable growth for the contractors' association since its last meeting, there being some fifty delegates present on this occasion. National Secretary W. H. Morton, of Utica, N. Y., was present and made a statement showing a wonderful growth on the part of the national association generally, in point of membership, finances and trade conditions.

The delegates were guests of the local Cleveland association. Mr. F. C. Werk, as state president, welcomed the members in a few well chosen remarks. The meeting together with the banquet was held in the well-known assembly room of the Hollenden Hotel.

Delegates were present from Cincinnati, Cleveland, Columbus, Toledo, Canton, Dayton, Springfield, and other points. Mr. E. M. Lawton, of Cincinnati, and Mr. J. C. McMaster, of Columbus, were elected state directors and representatives to the national meeting in Boston in July.

The convention adjourned to meet in Toledo the second Wednesday in August. All present were enthusiastic because of the growth of the association, and the advantages it offered to members.

An Electrolytic Telephone.

A novel electrolytic telephone has been invented by Herr E. Ruhmer, of selenium cell fame. This apparatus consists mainly of an electrolytic cell, with electrodes of unequal size. When the electrodes are traversed by microphone currents the cell reproduces the words spoken into the microphone, to which it is connected. The apparatus was recently exhibited at the jubilee exhibition of the German Electrical Society in Berlin.

Telephone and Telegraph Statistics.

Bulletin No. 17, of the Bureau of the Census, Department of Commerce and Labor, Washington, D. C., contains the most complete statistics of the telephone and telegraph industries that have ever been compiled for this country. The figures given in these statistics are for the year ending December 31, 1902.

The magnitude of these two industries and their relative importance are indicated by the following figures: there were in operation at that time 4,151 telephone systems and twenty-five telegraph systems. The former had 4,850,486 miles of wire; the latter, 1,318,350 miles, not including 16,667 nautical miles of submarine cable operated by submarine cable companies. The capital stock and bonds outstanding were for the telephone systems, $348,031,058; for the telegraph systems, $162,946,525. The total revenue of the telephone systems for the year was $86,825,556, and for the telegraph systems, $40,930,038. The total assets of the telephone systems were $452,172,546; for the telegraph they were $195,503,775. Of this, the value of the construction and equipment was $366,561,694 for the telephone; $156,911,448 for the telegraph. These totals do not include the rural telephone lines having no exchanges, nor the telephone and telegraph lines operated by railroads. Figures from the latter are given separately.

Taking up first the telephone, it is shown that the 4,151 systems had 2,178,366 subscribers, and had in use 2,315,297 telephones. Over these systems there were conducted 5,070,554,553 conversations. These companies employed 14,124 salaried officers, to whom were paid $9,985,886. There were 64,628 wage-earners, who earned $26,369,735. Their operating expenses and fixed charges, not including interest on bonds, were $61,652,823. The gross receipts from operation were $81,599,769.

The average number of messages sent during the year per telephone was 2,190. The average gross income for the year was $37.50 per telephone. The operating expenses were $24.56. The fixed charges were $3.58, leaving an average net income per telephone per year of $9.36. During the year the amount added for new construction was $51,903,021. There were 10,361 public exchanges. This represents the entire number of offices in which intercommunication is made between subscribers. There were 4,985 independent rural lines reported which do not operate exchanges. There were 7,783 private branch exchanges reported for the year.

Of the total 4,151 telephone companies, 44 were Bell and 4,107 independent companies. The Bell companies were operating 3,387,294 miles of wire; the independent companies, 1,462,562 miles. The Bell companies had 1,222,327 subscribers; the independent companies, 956,039. The former companies had in service 1,317,178 telephones; the latter, 998,119. There were in operation fifty-four companies using an automatic system, one of these being a Bell system, and the other fifty-three independent.

Of the 2,271 incorporated telephone companies, forty-four were Bell companies, and 2,227 independent companies. The par value of the capital stock and bonds outstanding for the Bell companies was $233,270,936; for the independent companies this was $114,760,122.

Of the twenty-five telegraph systems in operation, twenty-one were incorporated. The par value of the stocks and bonds outstanding was $162,146,525. There were 1,307,046 miles of wire. Of this, 816,593 miles were operated by the single Morse system; 185,048 by means of the duplex system; 294,910 by the quadruplex system, and 10,495 by machine or automatic systems. Of the total miles of wire in use, 21,658 were underground; 679 miles were in submarine cables, and 1,265,368 were overhead.

The commercial telegraph systems employed 829 salaried officers, who received $1,162,632, and 26,798 wage-earners, who received $13,877,041.

Six hundred and eighty-four railway companies reported the operation of telegraph and telephone lines in connection with their transportation business. The total miles of wire in these systems were 1,127,186. There were 17,606 telephones in use, and 85,753 telegraph instruments. The number of telegraph messages sent during the year for railway business alone was 201,743,756, and there were, in addition, 4,474,593 commercial messages sent over these lines.

Public Service Corporation Settles Dispute with Newark, N. J.

The city of Newark, N. J., has settled its dispute with the Public Service Corporation over the payment of five per cent of the gross receipts to the city by the company on all the trolley lines in the territory annexed to the city of Newark. An agreement has been draughted by City Councilor Coult, and has been approved by the officials of the Public Service Corporation. The agreement describes the territory affected, and stipulates that five per cent shall be paid on annual gross receipts within the city limits, whether the territory over which the tracks are laid was a part of the city prior to the agreement which originally instituted the five per cent payment, or has been annexed since, or may be annexed in the future. In the agreement the limits of the five-cent fare are also determined. The company is willing to carry passengers from one city boundary to any other city boundary, providing that it be not required to carry them over the Orange mountains, if the city should ever extend that far.

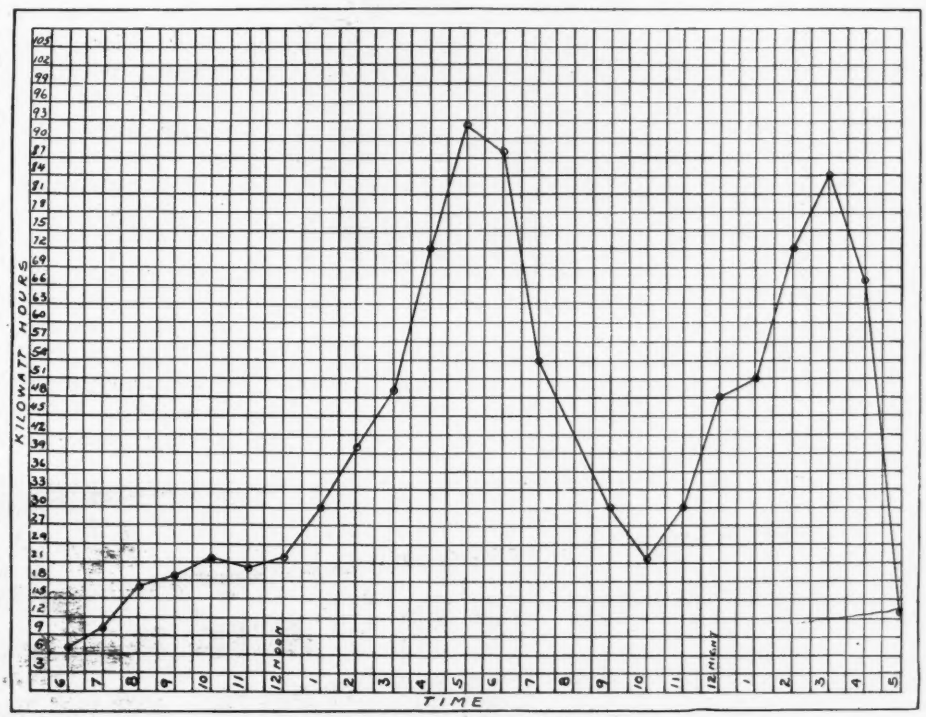
The agreement is the result of action taken by the city council of Newark, rescinding the permission given by the city as a property-owner to the Public Service Corporation to build a loop around the new city hall, and of a resolution passed by the city council requesting the Board of Public Works to show no favors to the Public Service Corporation until it had complied with the city's demand regarding the payment of five per cent of its gross receipts on all lines in the territory which had been annexed to Newark since the original agreement between the city and the corporation.

Organization of Texas Independent Telephone Association.

The Texas Independent Telephone Association organized in Dallas, Tex., January 5, 1905, with the following membership: E. M. Chamberlain, Greenville; C. A. Shock, Sherman; W. J. Johnson, Wills Point; R. T. Riddle, Weatherford; C. W. Roberts, Abilene; E. R. Webber, Orange; W. P. Johnson, Corsicana; F. B. McElroy, Dallas; E. W. Dunaway, Paris; H. C. Schumacker, La Grange; J. B. Earle, Waco; Charles W. Emmer, Beaumont. The association elected the following officers: E. W. Dunaway, Paris, president; vice-presidents, E. R. Webber, C. W. Roberts, W. P. Johnson; secretary and treasurer, J. B. Earle. The members present represented 12,580 telephones in actual use in Texas, and 4,250 miles of long-distance toll lines. This does not include any independent telephones or independent telephone lines, except such as were personally represented at the meeting. The association determined to confine its membership to bona-fide stockholders in or managers of independent telephone companies. Persons interested in the manufacture or sale of supplies for independent telephone companies are entitled to honorary membership. A paper was read indicating the policy of the owners of the independent telephone companies of Texas.

The Electrical Equipment of the New York "Times" Building.

THE new building of the New York *Times* is unique among large office buildings in New York in that it has no independent power plant. All the current used in the building is supplied by the New York Edison Company. A number of reasons influenced the choice of the outside service in preference to the independent plant. One of the most important was the fact that for a large part of the year there would be no fire in the basement, and the high heat which would attend the operation of a high-pressure steam plant in the summer months would thereby be avoided. This would also eliminate the necessity of providing a large and expensive ventilating system. Other reasons were the saving in space, the saving in first cost, and the saving in annual cost of operation. Furthermore, as the Edison company can furnish current from a number of different stations, the liability of a breakdown in the service is greatly diminished.



LOAD DIAGRAM AT "TIMES" BUILDING.

The Times Building has two load peaks —one between 5 and 6 P. M., due to the lighting of the offices and heavy service on the elevators about that time. The second peak is due to the operation of the presses in the early hours of the morning. To overcome these peaks it would be necessary to provide a large reserve equipment or an expensive storage battery plant. The load curve is shown in Fig. 1.

Current is brought into the building from three different Edison services—from Broadway, from Forty-second street, and from Seventh avenue, and is distributed by the three-wire system. A meter-board, shown in Fig. 2, is located at the point where each of these services enters the building. From each of these meter-boards ten cables of 800,000 circular mils carry the current to the main switchboard, which is shown in Fig. 3. The main switchboard is composed of three panels, each of which represents a separate service. Each panel is six feet long and seven feet ten inches high. The board is made of gray Tennessee marble two inches thick. The diagram of the switchboard is shown in Fig. 4. The upper part of each panel is devoted to the lighting circuits, and carries laminated, three-pole, double-coil combination switch and circuit-breakers. There are twenty-six of these circuit-breakers in all. They are so arranged that the neutral and one outside leg may be thrown out together, the remaining leg being independent. The power circuits are taken from the bottom of the board, and there are no circuit-breakers on this part of the system. It was not desirable that the presses should be stopped by any sudden rush of current, due to a small temporary overload, but the motors are amply protected by fuses. The centre portion of each panel of the switchboard is occupied by two 500-ampere recording ammeters and a special three-throw kiss switch which is shown in Fig. 5. This switch is designed so that each of the main panels may receive current from any one of the three Edison services. The lower portion of each panel, in addition to the power switches, carries a 2,000-ampere recording ammeter. A recording voltmeter is placed on the upper part of the centre panel.

In addition to the Edison service, subway current is used in the basement and first floor of the building on some of the lighting circuits. A transformer in the Times Square station of the subway transforms 11,000-volt current from the primary subway circuit to 220 volts. From this transformer a single-phase current is brought into the building and used in Nernst lamps and about 1,100 incandescent lamps.

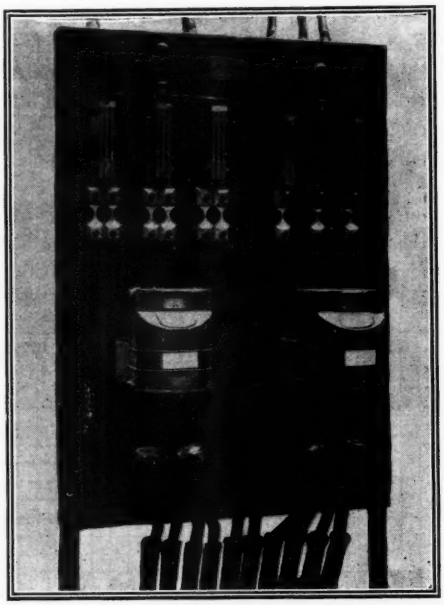
Three wires are taken from the main switchboard to each of the lighting panels on the different floors. Current is distributed from the lighting panels to the various lamps by two-wire circuits. In the various offices incandescent lamps are used, there being a chandelier and wall lights in each room. In the two arcades on the ground floor and in the basement Nernst lamps are employed as well as incandescent. The pressroom and composing room are lighted by Cooper Hewitt mercury vapor lamps, there being twenty-two in the pressroom and ten in the composing room. In addition to the mercury vapor lamps in the pressroom, twenty-eight incandescent lamps are installed in the press pits—seven in each pit, including one portable lamp. The Cooper Hewitt tubes are twenty inches long and one inch in diameter, and are arranged two lamps in parallel. Each tube is 300 candle-power, and three and one-half amperes are required for each pair of lamps. In addition to the other lamps in the building, fifteen arc lamps are used in various places, and also a Moore vacuum tube, which is on the alternating-current circuit. This tube is installed in the basement, near the ceiling, and conforms to the shape of the room lighted. A large searchlight is mounted on the top of the tower. The total number of incandescent lamps in the building is 6,205. All of them operate at 110 volts, except those on

the 220-volt, alternating-current circuit. One hundred and eight motors are used in the building, with a total of 1,175 horse-power. The four presses in the basement each has a seventy-five-horse-power motor, which operates the press at full load. The presses are controlled by the Kohler system. Two motors, one of fifteen and one of ten horse-power, are used in this system to start and control the presses and bring them up to speed. Until the presses are running at full speed, the seventy-five-horse-power motor is disconnected. After the press is at full speed the two smaller motors are thrown out, and the seventy-five-horse-power motor carries the load alone. A number of other motors are installed in the pressroom. There are two twenty-horse-power motors on the auto-plate machines, and eight twenty-four-horse-power motors on the paper hoists. The motors on the auto-plate machines are controlled by an adaptation of the Kohler system. A paper-conveyer, running from the pressroom to the ground floor, is operated by a ten-horse-power motor.

The linotype machines on the sixteenth floor are operated by thirty-eight special slow-speed, one-quarter-horse-power motors, which run at 650 revolutions per minute.

There are a large number of smaller motors, ranging from one-half to three horse-power, used on various machines in the press and composing rooms. These motors operate blowers, shavers, jig saw, trimmers, grindstone, proof-presses, job-presses, etc.

There are four high-speed passenger elevators, which are controlled by the

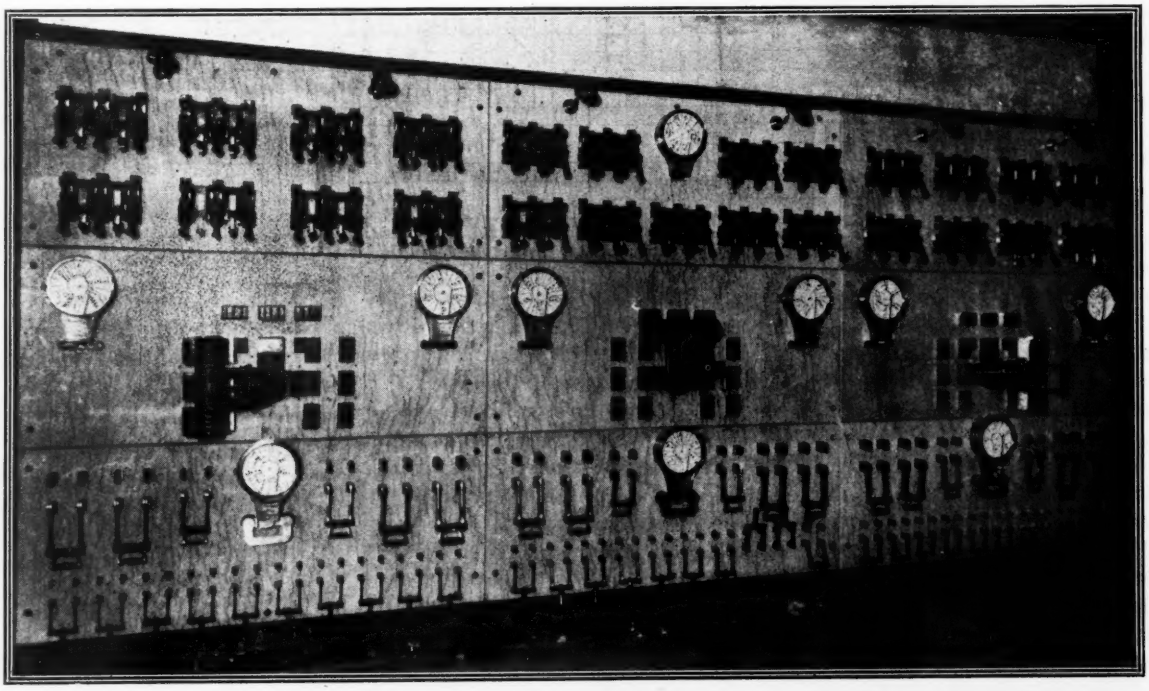


EDISON METER-BOARD, "TIMES" BUILDING.

Ward Leonard positive control system. One of these elevators has an ascent of 326 feet, one and one-quarter inches. Two of them have a rise of 217 feet, three and three-quarters inches, and one a rise of 201 feet, three-quarters of an inch. The elevators run at 350 feet per minute, with a maximum load of 3,000 pounds. Each elevator is run by a forty-horse-power motor. Three other motors, of twenty-five, seventeen and one-half and ten horse-power, respectively, operate tower and sidewalk elevators. An elevator which runs from the gallery in the composing room to the main floor of the composing room, is used for transferring the forms. The latter elevator is operated by a five-horse-power motor.

The water in the building is supplied by two Gould triplex power pumps, each of which is operated by a thirty-five-horse-power motor. These motors are connected to the pumps by means of Morse silent chain drives. In addition to the house pumps there are three sewage pumps, each operated by a ten-horse-power motor. These motors are connected to a float, so that they will automatically start when the water in the sewage manhole reaches a certain level, and stop when it has all been pumped out.

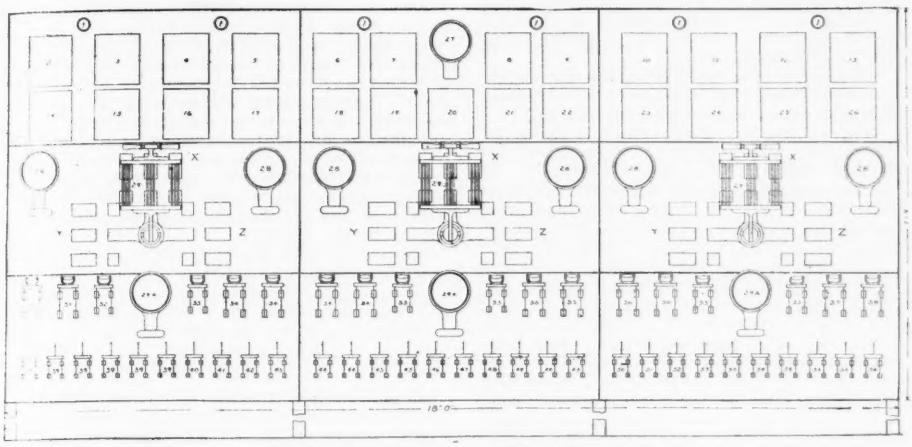
A complete system of pneumatic tubes is installed in the building for transferring matter from the different departments of the paper. Compressed air is furnished this system by means of an air-compressor which is operated by a two-horse-power motor. This motor starts automatically at any decrease of pressure in the system and stops when the normal working pressure is restored.



MAIN SWITCHBOARD, "TIMES" BUILDING.

All the motors in the building operate at 220 volts, with the exception of a few small motors of under one-half horse-power, which operate at 110 volts, and which are connected to the lighting cir-

cuits. For furnishing current for the messenger call, time clock, telephone service, etc., a motor-generator is installed in the basement. This furnishes a low-voltage current for operating the above devices. The motor-generator is connected to a storage battery system, which is used when the motor-generator is shut down. This motor-generator and storage battery system are controlled through a special switchboard in the basement.



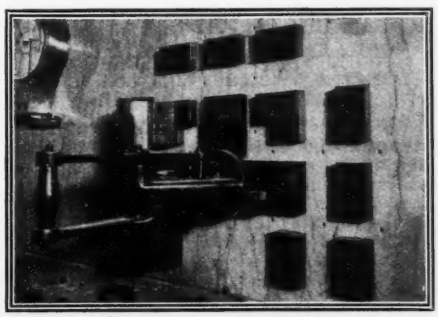
SWITCHBOARD DIAGRAM, "TIMES" BUILDING.

1—Two light brackets. Twenty-six circuit-breakers for service noted. 2—First floor. 3—20th, 21st, 22d floors. 4—17th, 18th, 19th floors. 5—16th floor. 6—13th, 14th floors. 7—11th, 12th floors. 8—9th, 10th floors. 9—7th, 8th floors. 10—5th, 6th floors. 11—3d, 4th floors. 12—2d floor display. 13—Second subbasement (A). 14—Spec. halls, 17th to 24th floors, inclusive. 15—15th floor. 16—23d, 24th floors. 17—Spare. 18—Spare. 19—Second subbasement (B). 20—Reg. halls, 17th to 24th floors, inclusive. 21—Reg. halls, 2d to 16th floor, inclusive. 22—Spare. 23—2d floor. 24—Basement. 25—Subbasement. 26—Spec. halls, 2d to 16th floor, inclusive. 27—Recording voltmeter. 28—Recording ammeters. 500-amperes. 29—2,000-ampere circuit-breakers; service No. 1. 29a—2,000-ampere recording ammeters. 30—Press switch. 31—Press switch. 32—15th floor power switch. 33—Spare switch. 34—Press switches. 35—Elevator switches. 36—House pump switches. 37—Heating apparatus switches. 38—Searchlight switch. 39—Six switches for two hoists each. 40—Vent fan switch. 41—Switch for vent motor at roof. 42—Switch for exhaust fan. 43—Switch for air-compressor. 44—Switch for paper dumbwaiter. 45—Switches for auto-plate machines. 46—Switches for plate shaver. 47—Switches for tail cutter. 48—Switches for machine shop. 49—Switches for elevators. 50—Switches for motor-generator (Bells). 51—Switch for Kenney vacuum sweeping system. 52—Switch for matrix heater. 53—Switch for moulding machine and steam tables. 54—Spare switches. X—Edison service No. 1. Y—Edison service No. 2. Z—Edison service No. 3.

Two hundred and fifty-seven telephone outlets are provided in the building, and four telephones can be supplied at each outlet. Eight hundred wires leave the building and connect with a cable of the New York Telephone Company under Broadway. Fifty-one telephones can be used at one time within the building. One hundred of these wires are used by the newspaper. One hundred and sixty-two wires are laid in cables from the Western Union and Postal Telegraph lines. Eighteen loops for instruments are arranged in the newspaper telegraph room, and provision is made for twenty-two more. The Western Union company's cable contains 100 wires. Fifty of these are led to the newspaper's telegraph room. The Postal Telegraph company has sixty-two wires running into the building, of which thirty are used by the newspaper.

In addition to the uses of electricity heretofore mentioned, it is also employed for the plate-warmers, coffee urns, tea-kettles, etc., in the restaurant; for heating soldering-irons, and for heating the stereotyping paste pot; also for heating hair curlers and tailors' irons. In dental work in the building it is used to operate a mallet, a gold annealer, a sterilizer, dental engine, mouth lamp, porcelain baking furnace, X-ray apparatus and cautery.

All the wires used in the building are rubber-covered. The insulation was tested up to 5,000 volts before installation. Twenty-one miles of conduit and seventy-five miles of wire are used in the building, running from the main switchboard to the various appliances and lights. All wiring is done on the Edison three-wire system, with a voltage of 220 between the two outside wires, and 110 between either outside and the neutral wire. In all cases



THREE-THROW KISS-SWITCH AT "TIMES" BUILDING.

the neutral wire has twice the cross-section of either of the outside wires, the sizes of most of the sets being No. 2, No. 00, and No. 2, respectively. All cables in the building run in iron pipe to the panel-boards and motors. The panel-boards are all of marbleized slate, and are arranged with the bus-bars exposed on the surface. The wiring has been so designed that the load can be increased about thirty-eight per cent without any change being made.

All the cables are carried from the main switchboard in the basement to the upper floors in shafts which are located at the north and south of the elevator shafts, and which run from the bottom to the top of the building. In order to take the strain incident to the great length from the upper end of the cables at the top of the wire shafts, special pull boxes were arranged at the seventh and fifteenth floors. These pull boxes consist of a box containing an iron rod, on which are strung porcelain insulators. The cables are looped around these insulators and fastened. The north shaft supplies all floors below the seventeenth, the tower of the building being supplied by wires in the south shaft. The north shaft contains, at the ground floor, twenty-five conduits, in addition to space for the telephone service. The south shaft contains ten conduits, which are used for the lighting service only.

The wiring plans were furnished by Clark & MacMullen, and the wiring was done by Peet, McAnerney & Powers, of New York city.

Electric State Railway Experiments in Sweden.

United States Consul S. S. Bergh, at Gothenburg, Sweden, gives some additional information with regard to the electric railway tests which are to be carried out on the Sweden state railways. Some time last spring the railway board petitioned the government for permission to erect electric transmitting apparatus on land belonging to the state, between Tomteboda and Värtan, in order to carry out the experiments with electric traction, for which a grant of $134,000 had been made by the Riksdag. At Tomteboda station double wires will be used, and at Värtan the contact system will be employed for transmitting the current from the power station to the electric locomotive or motor-car. The rails will serve for the return current. For these experiments a high-tension, single-phase, alternating current will be used. The tension and frequency will be varied as desired.

These experiments are of much importance to the entire country, and the board of trade has recommended that the request of the railway board be granted, provided the permission to erect and use the apparatus be limited to a certain period, say, five years, and that private rights be protected.

Thirteenth Annual Convention of the Northwestern Electrical Association, Milwaukee, Wis., Wednesday, Thursday and Friday, January 18, 19 and 20, 1905.

WEDNESDAY MORNING SESSION.

THE thirteenth annual convention of the Northwestern Electrical Association was called to order on Wednesday, January 18, 1905, at 11.45 A. M., in the clubroom of the Hotel Pfister, Milwaukee, Wis., by the president, Mr. T. F. Grover.

After the usual routine of calling for and approving the minutes of the last meeting was dispensed with the president delivered his annual address, an abstract of which follows:

"The past year, I believe, has been a successful one to the great majority of the central stations as well as to the street and interurban railway interests. Electricity is constantly reaching out and finding new industries to conquer. The last year will go down in history as an eventful one in electrical industries. One of the more important achievements being the opening of the great New York subway, which would not have been possible without the aid of electricity. The perfecting of the single-phase railway motor has done much for the interurban railway, as it permits the transmission of electrical energy for greater distances, and by the use of transformers does away with expensive substations and opens the way for the speedy conversion of steam railways to electric.

"But little has been heard of 'municipal ownership' in the territory covered by this association during the past year. Municipal plants now in operation have failed to show the large profits predicted, and it is easily to be seen by all fair-minded business men that a corporation, properly managed, operating commercial lighting, power and railway plants, can and does furnish better and cheaper street lighting than can be furnished independently by any political body."

The secretary's report was then rendered and approved, and a recess taken until 1.30 P. M.

WEDNESDAY AFTERNOON SESSION.

After calling the convention to order the president appointed as a nominating committee, J. H. Harding, O. M. Rau and R. M. Kimball.

Membership committee: S. B. Livermore, P. H. Korst and W. B. Jackson.

The report of the legislative committee was then presented.

LA CROSSE, WIS., Jan. 17, 1905.

NORTHWESTERN ELECTRICAL ASSOCIATION,
Milwaukee, Wis.

Gentlemen—I beg to submit the following report on legislation in the several states covered by this association. So far as the subcommittees have reported there has been nothing of much moment to the electrical business enacted or proposed since our last meeting.

The committee from Iowa reports an act covering malicious mischief and trespass which I append here to be read in full.

The committee from Illinois reports no bills passed detrimental to electrical interests.

The committee from Indiana reports a bill for an act concerning municipal corporations pending before the state legislature of Indiana, and expects to have a copy of same to read to convention.

The committee from Michigan does not reply to my request for a report.

The committee from Wisconsin also makes no report, although ample time has been given it to reply to my request for a report. In relation to Wisconsin, I append the heading of Governor La Follette's new bill on taxation of electric and gas properties, street railways, and life insurance companies, which bill the Wisconsin members can procure from their representatives for reading.

The committee from Minnesota reports no meeting of legislature last winter, and so far as can be learned nothing important has been introduced this term.

This covers the states except Michigan, and there has been almost nothing done to change the existing laws governing our business. Your general chairman has changed his residence from Minnesota to Wisconsin, and is no longer eligible to serve on Minnesota's subcommittee.

Respectfully submitted,
S. B. LIVERMORE,
Chairman committee on legislation.

CEDAR RAPIDS, IOWA, Jan. 12, 1905.

The following laws were passed by the thirtieth General Assembly of the State of Iowa affecting electrical interests:

Chapter 130.

MALICIOUS MISCHIEF AND TRESPASS.

H. F. 381.

An act to repeal section four thousand eight hundred and seven (4807) of the code and of the supplement to the code, and to enact a substitute therefor, relating to malicious mischief and trespass.

Be it enacted by the General Assembly of the State of Iowa:

Section 1. Repealed—Malicious injury to highways, bridges, railways, telegraph lines, etc. That section four thousand eight hundred and seven (4807) of the code, as the same appears in the code and the supplement to the code, be, and the same is, hereby repealed and reenacted; and when reenacted, the same shall read as follows:

"If any person maliciously injure, remove or destroy any electric railway or apparatus thereto belonging, or any bridge, rail or plank road; or place, or cause to be placed, any obstruction on any electric railway, or on any such bridge, rail or plank road; or wilfully obstruct or injure any public road or highway; or maliciously cut, burn, or in any way break down, injure or destroy any post or pole used in connection with any system of electric lighting, electric railway or telephone or telegraph system; or break down and destroy or injure and deface any electric light, telegraph or telephone instrument; or in any way cut, break or injure the wires of any apparatus thereto belonging; or shall wilfully tap, cut, injure, break, disconnect, connect, to make any connection with or destroy any of the wires, mains, pipes, conduits, meters or other apparatus belonging to, or attached to, the power plant or distributing system of any electric light plant, electric motor, gas plant or water plant; or shall aid or abet any other person in so doing, he shall be imprisoned in the penitentiary not more than five years, or be fined not exceeding five hundred dollars, or imprisoned in the county jail not more than one year, or by both such fine and imprisonment at the discretion of the court."

Approved March 30, A. D. 1904.

Chapter 132.

THE WILFUL TAKING OF ANY ELECTRIC CURRENT, GAS OR WATER FROM THE WIRES, METERS OR PIPES.

H. F. 382.

An act prohibiting the wilful taking of any electric current, gas or water from the wires, meters, pipes or any apparatus of any electric light, electric motor, gas or water plant with intent to defraud.

(Additional to chapter five (5) title twenty-four (xxiv) of the code.)

Be it enacted by the General Assembly of the State of Iowa:

Section 1. Larceny—If any person wilfully and with intent to defraud, in any manner take from the wires, pipes, meters or any other apparatus of any electric motor, electric light, water or gas plant or works, any electric current, water or gas, he shall be guilty and shall be punished accordingly.

Approved March 30, A. D. 1904.

Respectfully submitted,
W. J. GREENE,
Chairman subcommittee.

DIXON, ILL., Jan. 7, 1905.

In reply to yours of the 7th will say that the Illinois Electrical Association has looked after legislation in this state. There was no bill passed detrimental to the business.

ED. P. MAXWELL,
Chairman Illinois state committee.

LA PORTE, IND., Jan. 7, 1905.

Answering your letter of the 6th, we beg to report that the legislature does not meet until the 9th of January. We were at Indianapolis yesterday looking up this matter, and are happy to report, that so far there are no bills reported that are hostile to us. Should there be any introduced later on we will so report.

J. H. HARDING.

LA PORTE, IND., Jan. 14, 1905.

We beg to report that there is a bill for an act concerning municipal corporations pending before the state legislature of Indiana; so far we have been unable to get hold of a copy of the bill, but hope to be able to bring one to the convention.

J. H. HARDING,
Chairman Indiana legislative committee.

The committee on uniformity of advertising matter made a report, which

was accepted, and the committee was ordered continued during the ensuing year.

The following applications for membership were received, and the secretary instructed to cast one ballot:

ACTIVE—John Powers, Sterling, Ill.; George P. Dravo, Milwaukee, Wis.; J. Carson, Duluth, Minn.; J. B. Hirst, Kenosha, Wis.; John Wright, Antigo, Wis.; W. E. Haseltine, Ripon, Wis.; Mt. Morris Electric Light and Power Company, Mt. Morris, Ill.; Oak Park Yaryan Company, Oak Park, Ill.; La Crosse City Railway Company, La Crosse, Wis.; H. B. McMeal, Chicago, Ill.; C. J. Schram, Lake Geneva, Wis.

ASSOCIATE—Jewell Belting Company, Chicago, Ill.; Kaukauna Electric Light Company, per A. R. Coates, president and manager; Allis-Chalmers Company, by B. H. Warren, president, Milwaukee, Wis.; Western Display Company, per T. R. Willmerscheid, president, St. Paul, Minn.; Nernst Lamp Company, Pittsburg, Pa.; Burton C. Dinius, Zion City, Ill.; Bullock Electrical Manufacturing Company, Cincinnati, Ohio; W. D. Keuz, Marinette, Wis.

A paper by Mr. W. B. Jackson, Madison, Wis., was read on the subject of the "Successful Joint Utilization of Several Small Water Powers by the Janesville Electric Company," an abstract of which follows:

I have in mind a city of about 17,000 inhabitants, which has no less than three separate hydroelectric plants, two of these being provided with steam auxiliaries. This is the system of the Janesville Electric Company, of which one of our past presidents, Mr. P. H. Korst, is the manager, and in the details of which he takes an intimate interest.

This plant, like numerous others in our western cities, started many years ago, when the town was young. Its growth was continuous with the town until it was operating about 130 horsepower of water-wheels and had an engine capacity of 350 horse-power, located in the centre of the city.

About this time it had the opportunity to add to its available power, under favorable conditions, the Fulton hydroelectric plant, at a distance of about twelve miles from the central plant. In this transmission three-phase, alternating current, at sixty cycles and 6,000 volts, is generated from the power of the Yahara river.

It was not long before further power was required by the company, and it was again enabled to add to its resources another hydroelectric plant. This is its present Monterey plant, located about three miles south of the city, upon the Rock river. Here 350 horse-power of water-wheels and a 350-horse-power engine have been changed from driving a cotton mill (their original sphere of action) to driving a 275-kilowatt, alternating-current generator, which furnishes three-phase current at sixty cycles and 2,300 volts pressure.

Thus the electric company had acquired, step by step, a system comprising:

A centrally located hydroelectric plant with steam auxiliary together with the requisite distributing circuits and translating devices.

A hydroelectric plant transmitting three-phase, 6,000-volt alternating current twelve miles to the central plant; and a second hydroelectric plant with steam auxiliary, transmitting three-phase, 2,200-volt electric current three miles to the central plant.

The distributing system comprises a three-wire, 125-volt direct-current service furnishing the lighting and power for the central section of the city; a 500-volt street-railway circuit for operating the street railway of the city; three-phase alternating-current distributing circuits for furnishing light and power to the outlying districts of the city; and alternating-current series arc-lighting circuits.

As the central station had outgrown its quarters, and conditions made it undesirable to remain in its old location, it was decided to build a new plant at a point where a much better hydroelectric development could be accomplished, but still affording a centrally located plant for general distribution throughout the city.

The question then confronted the company of determining the best arrangement for the new plant so as to bring together in one united whole the several plants under its control, in order that it might give the most efficient and most satisfactory results in all of the several classes of service to be supplied by its system.

All of the apparatus in the old station was in excellent condition, but it was in small units. Nevertheless, it was decided to utilize practically all of it in the new plant, adding thereto only what was required to take care of the increasing load.

There are not infrequent cases when old apparatus is thrown aside in the reorganization of electric plants to be replaced by more modern and possibly slightly more efficient apparatus, when the actual added net returns from such a change are far less than the added fixed charges, and which, had the old apparatus been suitably continued in service, would have given thoroughly reliable and satisfactory results for many years to come at a positive net saving to the company.

Some of the details of the Janesville system should be of considerable interest to those concerned with the generation and utilization of electric current.

There are installed in the new central plant referred to 780 horse-power of water-wheels driving a single shaft extending through the building. This shaft is appropriately subdivided to permit operating portions of the plant while the others are at rest or undergoing repairs.

Belted to the shaft upon one side are the driving elements, comprising a 350-horse-power Corliss engine and two synchronous motors, one for 6,000 volts, the other for 2,200 volts. All of the driven elements, comprising two 125-volt and three 250-volt, seventy-five-kilowatt, direct-current dynamos and one 110-kilowatt 500-volt dynamo, can be belted to the shaft from the other side.

Thus suitable space is obtained for all of the driving and driven machinery and at the same time the belt-drive of each unit can be arranged to possess the advantages of having the lower belt upon the pulling side.

Although the usual work of the synchronous motors is to receive power from the other plants and assist the water-wheels in driving the main shaft of the central plant, yet when desirable they are driven and used to supply the alternating current required for that portion of the lighting and power system.

By the use of transformers located between the 6,000-volt section and the 2,200-volt section of the switchboards, the 6,000-volt apparatus may be operated in connection with the 2,200-volt apparatus with practically the same facility as though everything was at one pressure.

The arrangement of the switchboard is simple, but affords the possibility of operating any one of the plants singly or in any combination with the other plants that the stage of the water may make desirable.

By the arrangement above noted a thoroughly practicable and efficient combination is obtained whereby all of the power for supplying the entire service of the electric system may be drawn from any one of the three plants, and two of the plants are equipped so that the power may be furnished either by water or steam, as conditions warrant. An efficient combination of the several plants is thus accomplished and the company is remarkably well fortified against possible interruptions of service. Only a very unusual coincidence can simultaneously disable all of the sources of supply.

Mr. C. M. Rau, of Milwaukee, read a paper entitled "Direct-Current *versus* Alternating-Current Distribution." Mr. Rau said, in part:

There has been considerable controversy as to the stability of a sixty-cycle rotary compared to that of a twenty-five-cycle rotary. This argument had considerable weight before the advent of the turbine, but by having a rotating instead of a reciprocating engine for the prime source of power, the stability of a sixty-cycle rotary is equally as reliable as that of a twenty-five-cycle rotary, and therefore the sixty-cycle current becomes just as suitable for direct-current railway systems as the twenty-five-cycle, and naturally is directly applicable for lighting and power service, and becomes readily convertible by static transformers for the various distributing systems required by a lighting installation. Particularly is this favorable for the central or business districts of a city, as the installation of static transformer substations is inexpensive compared with the large investment of copper or the frequent location of rotary stations with their attendant losses in efficiency and expense of maintenance.

The usual practice in operating a direct-current system from a high-tension alternating power plant requires the installation of frequent substations equipped

with standard apparatus, consisting of necessary transformers, regulators and rotary converters. From this the current is distributed through the usual low-tension switchboard, feeders, mains, etc., to the customer's premises.

For an alternating-current system the current would be taken directly to static transformers, which would be placed at such locations as the concentration of load would indicate, and would be located at more frequent intervals than rotary substations, thereby avoiding the extensive system of feeders, as the current would be taken directly from the low-tension side of the transformers to the mains.

In comparing the efficiencies of an alternating-current and direct-current system the calculations were based on the assumption that the static transformers were to be located at the same points as rotary substations and in units equivalent to the direct-current rotary converters and cut in and out of use similarly to rotary apparatus as the load increased or diminished, using the usual system of feeders as employed on a direct-current system to distribute the load to the mains.

The next important question is the comparative cost of the installation. The calculations were based on a station having a capacity of 15,000-kilowatt full-load output. This showed a saving on the cost of apparatus and buildings for substations alone of $130,000, which is entirely due to the smaller space required for static transformers, and the difference in cost between the necessary converting apparatus from alternating to direct current as compared with the cost of static transformers for the alternating system.

We, therefore, have as an increased economy up to the customers' premises on the alternating-current system the saving due to the difference in losses, the savings on interest due to the smaller investment and the saving on depreciation due to simpler installations, which amounted, on the installation above referred to, to somewhat more than $75,000 per year, the output of the previous year being used on which to calculate the value of the losses.

So far the investigation from a financial point of view leaves no question as to which system of distribution to adopt.

The next question to receive consideration is the relative commercial value of the two currents, and it is on this question that the difficulty is encountered of persuading the interests controlling the large direct-current systems to change to alternating-current systems.

After a most exhaustive investigation of this part of the question there was found, in a city of some 600,000 inhabitants, no installation which is now served by a direct-current system, which could not be served equally as well, if not better, by an alternating-current system.

As to purely electric lighting service, the alternating current is more suitable than the direct current, giving a greater variety of uses, as well as a more effective means of distributing light. The incandescent lamp is equally effective on both systems, so also the arc lamp, while the Nernst lamp adds materially to the advantages of alternating-current lighting, and the ability to do decorative lighting by means of low-voltage lamps through the introduction of transformers opens a field of economy in this class of work which could not be attempted with direct current.

For ordinary power work the alternating-current motor is superior to the direct-current motor, as the abolishing of brushes is a decided advantage where a large number of small motors is in use. In looking up the trouble calls from power customers it was found that fully seventy-five per cent were due to brush or commutator trouble.

The greatest difficulty to overcome is the variable-speed motor customer, but as this class of service is limited to the larger users of power, they could be readily accommodated by the installation of motor-generator sets for each individual case.

The operation of elevators is also difficult to take care of with the alternating-current motor, but with the development of the single-phase railway motor a suitable elevator motor can not be far off, and all that is needed is the creation of a demand for apparatus of this class, when, no doubt, our associate members will be ready to supply the demand.

In conclusion it might be stated that on the favorable showing made by this investigation, a change has been made from a direct-current, three-wire Edison system to an alternating-current, sixty-cycle, single-phase system in the city of Racine, Wis., which is an active manufacturing town and has a population of 30,000 inhabitants, and where every practical class of service was met that could be covered by a central station system.

In the discussion which followed the reading of this paper Mr. Colles said he thought this question was about the most important that is now before the electrical world, especially important to large towns.

The one great disadvantage under which the alternating-current labors in distribution is the lack of a suitable variable-speed and variable-load induction motor. All other problems are practically solved he said, so far as the alternating-current distribution is concerned. We have just as good lights and lighting service in the alternating service as in the direct, and for constant motor work, in machine shops or any other shop, the induction motor is practically just as good, so far as the efficiency is concerned, and in many other respects a great deal better than the direct-current motor; but for any place where a variable load is needed, it is far from being what it ought to be, and he thought that this was the sticking point of almost all of those who consider the question of installing that system.

Mr. Alment said the question of transformer capacity for consumers in smaller places where the load is irregular is a serious one; and while Mr. Rau's plan from a central station standpoint is excellent, and we all hope to get it, yet some better proposition in most communities for disposing of apparatus exchanged must be made.

Mr. Kimball asked Mr. Rau whether he has limited the size of single-phase motors installed in Racine.

Mr. Rau replied that this had not been done, although in the total installation in Racine there was not anything larger than five horse-power. That is one of the advantages in going through a customer's installations on an occasion of this kind. They are usually made irrespective of engineering principles. He cited an instance where a manufacturing plant using sewing-machines had a five-horse-power motor running half a dozen machines. There were only two months in the year when the manufacturer ran to the full capacity of five horse-power. A proposition was made by which two motors were installed, one of one horse-power and one of three horse-power respectively; the first year's business will pay the entire cost of a change of motors.

Following the discussion a communication was read from the National Electric Company, of Milwaukee, extending an invitation to the delegates to visit the company's works.

The secretary read a paper on the subject of "The Rating of Arc Lamps," by Professor George D. Shepardson, of Minnesota University. Professor Shepardson's paper dealt mainly with the methods of making up lighting contracts so that the best interests of both supplying company and consumer might be considered. He said:

It is a difficult matter to word a contract for street lighting so as to be fair to the city and to the company, so that each party knows exactly what is both the intended and the actual meaning of the terms, and so that either party can determine fairly whether the contract is being properly carried out. The city wishes to obtain illumination of the streets and landscape, together with a certain amount of what is sometimes called illumination appearance. Where simply illumination is desired, the people are satisfied with any sources of light that will illumine the roadway so that one can see to walk or drive with a fairly good vision of the path. In addition to this there is a general desire to have the streets appear to be lighted; in other words, to have the sources of light conspicuous. For the latter purpose, nothing can compare with the open arc with its intense brilliancy

and its deep shadows, although a Nernst lamp with clear globe approximates it. The modern enclosed arc light loses much of the illumination appearance characteristic of the older open arc and also gives out less total light, but it has less pronounced shadows and it throws nearly as much light to distant points.

Since light is what is desired, or rather illumination, it would seem that the most rational basis for a contract for street lighting would be an illumination of the street surface, which should have certain average values on main streets, certain lower averages on others, and whose minimum values should not fall below certain specified values according to the importance of the streets. To avoid uncertainties in measuring, care should be taken to specify whether the illumination is to be measured on the horizontal or vertical plane, the latter favoring widely scattered light sources, such as arc lights.

Lighting contracts based upon the illumination produced would put all sorts of light upon nearly the same basis, and would render it comparatively easy for city or company employés to make fairly reliable tests whenever desirable.

In cases where companies do not care to sell illumination as such, it would be some improvement over present contracts based upon nominal candle-power to charge by the kilowatt-hour. Contracts for lighting streets by gas are frequently based upon a fixed charge per thousand cubic feet estimated from hours of burning and periodical tests of consumption by various burners taken at random and tested under working pressure. In this case the city requires periodical cleaning of the globes and assumes that the street illumination is satisfactory. Such tests are difficult in the case of mantle burners, and unless provision is made for renewal of mantles when broken and after a definite period of service, there is apt to be much poor illumination.

It would not be difficult to provide for similar sort of testing for electric lights. The circuits might be run into testing stations established in fire department houses or police stations where instruments could be plugged in at will to measure the current. Occasional tests on the line with voltmeters would check the adjustment of individual lamps with sufficient accuracy. In the case of alternating-current lamps, an occasional wattmeter test is not a difficult matter.

One of the most satisfactory methods would be to have integrating wattmeters at the power-house, so as to measure the entire energy delivered to the street circuits for both arc and incandescent lighting. While this method would measure the energy lost on the line and in translating devices other than the lamps, suitable allowance could be made in the contract.

The main objection to contracting for street lights on the basis of energy consumption is that there is no definite relation between kilowatts and candle-power. In the case of incandescent lamps, the size, initial candle-power, age and method of manufacture all enter into the amount of light per watt, and the street fixture exerts an influence more or less. In the case of the arc lamp, the light is affected by the globes and coatings, by the size and quality of the carbons, by the length of the arc and perhaps by the power-factor.

Mr. R. N. Kimball, of the Kenosha (Wis.) Gas and Electric Company, said he had a 2,000-candle-power so-called contract, and was using what he called a 450-watt lamp. Recently where his company put in wattmeters on the board it was able to show the city council at any time the daily readings. There is now no controversy as to whether they are getting the light or not, and that is a very satisfactory way to close up a discussion.

Mr. H. Almert, of the Cicero Light, Heat and Power Company, Oak Park, Ind., said his company started to use wattmeters for its own protection, in trying to determine the amount of current lost or stolen, and found the plan satisfactory. It adopted it also when it wanted to check up the street lighting system, to see what it actually did get on a kilowatt-hour basis for current.

Mr. C. H. Williams, of Madison, Wis., read a paper entitled "Distribution and Dollars."

Mr. Williams considers that every problem which arises in electrical engineering may be reduced to a dollar and cents basis, and that the engineer of the present day is called upon not only to reach a certain clearly defined result, but to accomplish it with due regard to the investment and expenses entailed. Engineers, he thinks, are gauged by the results which they obtain, and in this particular line the gauge is most likely to be graduated to dollars or dividends, and the dividends will not be long forthcoming unless good service is rendered, while good service can not be secured without following sound engineering principles. The paper dealt with the factors regulating the size and number of feeders to be installed, the choice of size of transformers and secondary feeders, regulation as affecting renewals, the necessity of keeping accurate distribution records, means for obtaining satisfactory regulation, transformer losses affecting distribution costs, heating effects in transformers, regulation of transformers, records of transformer tests, lost and unaccounted-for current, transformer losses, resistance losses, card systems for keeping records of connected loads, meter-shunt loss, selection of incandescent lamps, and cost of lamps.

After a brief discussion, Mr. J. W. Pogue, manager of the Milwaukee (Wis.) branch of the Sheldon School of Salesmanship, was introduced. Mr. Pogue made a lengthy address on the method of modern salesmanship and the special training which was now undertaken to fit the men for this service.

Mr. E. C. Eastman, of Marinette, Wis., was introduced, making a few brief remarks, after which recess was taken until Thursday.

THURSDAY MORNING SESSION.

Discussion was reopened on Mr. C. H. Williams's paper entitled, "Distribution and Dollars." Mr. H. Almert thought the question of standardizing the sizes of transformers was an ideal one. He doubted very much whether the same result could be accomplished in any of the properties with which he was connected. In the outlying districts, which are not necessarily very distant in small towns, the work becomes scattered, and feeder capacity and secondary distribution become a very serious question very early, and it is not very far from the station or substation before individual transformers are necessary.

Following the discussion on Mr. Williams's paper, a discussion ensued relative to the presentation of advance copies of papers read before the convention. It was moved and adopted that the president be empowered to delegate two members to lead in the discussion on any particular paper, these members to be notified in time to prepare for such discussion.

Discussion was then reopened on Mr. O. M. Rau's paper entitled, "Alternating-Current *versus* Direct-Current Distribution."

Mr. I. M. S. Waring said that during the discussion of Mr. Rau's paper at yesterday's meeting, some statements had been made relative to storage batteries which may have created an impression that was entirely foreign to Mr. Rau's intention. The principal applications of batteries, the systems of Edison distribution, are first, batteries at the rotary substations; second, substations of batteries only installed at heavy distributing centres on the low-tension system. Illustrations of both of these types may be found in practically all of the large cities, notably New York, Chicago, Brooklyn, Philadelphia, Washington, St. Louis, etc. In each of these cases the cost of the battery is almost, if not entirely, offset by the additional investment in boilers, engines, generators, rotaries and static

transformers that would be unnecessary without batteries.

In the second case, *i. e.*, battery substations at distributing centres in the low-tension system, besides the saving in power-house and central station apparatus, a saving in copper is effected which makes the comparison decidedly in favor of batteries. Without this class of battery sufficient copper is necessary to transmit the maximum current demand from the rotaries to the distributing centres, while with the battery this transmission is materially reduced. In each case the batteries are discharged at the time of maximum demand and charged at a period of light load. The load-factor of the entire system is increased with a resulting increase in efficiency of all apparatus from the boiler room to the low-tension distributing centres.

The paper by Mr. E. P. Warner, on the subject of "Series Alternating Arc Lamps," was read and discussed.

Mr. Warner summed up in his paper the mechanical and electrical characteristics of the two systems. His conclusion was that the results which had been achieved in series alternating arc lighting during the past three years were of a character to give confidence to the central station engineer that the system had come to stay and was one which might be safely adopted.

The nominating committee of the association submitted the following names for the officers and directors for the next year, which were unanimously adopted and the gentlemen declared elected:

President, C. H. Williams, Madison, Wis.

First vice-president, Roger N. Kimball, Kenosha, Wis.

Second vice-president, H. Almert, Oak Park, Ill.

Secretary and treasurer, Thomas R. Mercein, Milwaukee, Wis.

Directors, P. H. Korst, Janesville, Wis.; Ernest Gonzenbach, Sheboygan, Wis.; H. J. Gille, St. Paul, Minn.

Mr. Williams thanked the association for the honor it had conferred upon him. He felt that it had placed a great responsibility upon somewhat inexperienced shoulders, but with the help of all he would try to make up in activity what he lacked in experience.

THURSDAY AFTERNOON SESSION.

The session was called to order by the president at 2 P. M. Discussion on Mr. E. P. Warner's paper, entitled "Series Alternating Arc Lighting," was opened by request by Mr. A. A. Morton, of Pittsfield, Mass. There is one thing he thought ought to be brought out very prominently in this arc-light question, and that is, that it is impossible to get together and say that the series alternating system is the thing for everybody to put in. He had done a good deal of traveling through this part of the country, and while he felt that the series alternating system is what we are all coming to, and have got to put in eventually, it did not seem to him that one can take up every plant and say that now is the time to put in the series alternating apparatus.

The next paper was by Mr. W. T. Goddard, on "High-Tension Practice." This consisted largely of lantern slides, described by the speaker.

A paper by Mr. Clarence Renshaw, of Pittsburg, was read on "Single-Phase Railways and Their Possibilities." This paper was illustrated by stereopticon slides, and detailed the characteristics of the single-phase system in its application to railways. This paper was discussed briefly after which the convention took up the paper by Mr. Norman McCarty, entitled "Economy and Working of the Diesel Engines."

Mr. McCarty's paper was discussed at length, the performance of this type of engine attracting considerable attention and producing a marked impression in favor of the internal combustion machine. A vote of thanks was extended to Mr. McCarty.

The paper by J. W. Shuster, of the University of Wisconsin, was read. This paper discussed "Motor Adaptability." This paper rehearsed the principal features of the various commercial forms of motors, and their bearing on central station practice.

After a brief discussion the convention adjourned until ten o'clock Friday morning, at which time, there being no further business, adjournment was taken *sine die*.

Convention Notes.

A LARGE delegation from Chicago to the thirteenth annual convention of the Northwestern Electrical Association arrived in Milwaukee about eleven o'clock Wednesday morning, over the Chicago, Milwaukee & St. Paul Railroad. A parlor car had been chartered by the H. T. Paiste Company, of Philadelphia, and placed at the disposal of the delegates. Mr. James Wolff, western manager of this company, acted as host. Refreshments were served, and every attention given to the delegates, who enjoyed the greatest possible comfort.

Milwaukee, being the home of the National Electric Company, this company made elaborate arrangements for the reception and entertainment of the delegates to the convention. The company exhibited at the Hotel Pfister—the headquarters of the association—some of its specialties. Several bromide enlargements were hung on the walls, giving an excellent idea of a few of the larger electrical machines made by the National company. A reproduction of particular interest was that of the 1,000-kilowatt rotary converters recently supplied to the Milwaukee Electric Railway and Light Company, and another was that of two 1,000-kilowatt units, comprising a motor-generator set, supplied to the Union Electric Light and Power Company, of St. Louis, Mo. This latter set is one of eighteen 1,000-kilowatt units which are being supplied to the city of St. Louis, to be employed as motor-generators and frequency changers. This is an order of which the northwestern engineers are justly proud. The new Lundell universal motors attracted special attention. The radical feature of construction is a magnetic circuit entirely composed of laminations, thus giving a homogeneous field. Other features of novelty which are comprised in this motor are an improved brush-holder and an improved design of the commutator. The motor is especially suitable for variable-speed work, and a standard ratio of three to one is advocated by the National company. Bulletin No. 400, describing this motor, was distributed at the convention. A new publication, entitled "The National Electrical Catechism," was presented to each visitor.

The trade-mark adopted by the company consists of two half-sections of generators, placed one above the other—the lower part representing the alternating-current, and the upper half the direct-current machine—the two portions being joined by a scroll bearing the word "National." As a souvenir of the convention, a handsome watch fob was given away, bearing as a charm a bas-relief representation of the company's trade-mark. The company also issued passes over the street

railway system, and tendered a reception to the delegates at its works.

Among the representatives of the company present were the following: S. W. Watkins, president; B. T. Becker, assistant general manager; Robert Lundell; C. G. Burton, sales agent; W. L. Waters, chief engineer; W. J. Richards, assistant engineer; A. P. Peck, sales agent; J. H. Denton, general superintendent; R. P. Tell, secretary and treasurer; Robert T. Lozier, general manager electrical sales; H. M. Klingenfeld, advertising manager.

The Allis-Chalmers Company and the Bullock Electric Manufacturing Company had an elaborate exhibit of apparatus at the Hotel Pfister. The company distributed to the delegates a watch fob bearing the trade-mark of the Allis-Chalmers Company on one side, and the trade-mark of the Bullock company on the other. These souvenirs were greatly appreciated and very much in evidence.

Among the representatives of the Allis-Chalmers and Bullock companies were Arthur Warren, manager of the department of publicity; George B. Foster, Chicago sales agent; H. S. Mallalieu, department of publicity; L. F. Raines, department of publicity; E. N. Dickson, purchasing agent; Harry Byrne, sales department.

Among other exhibitors and representatives in attendance were the following:

Westinghouse Electric and Manufacturing Company—Walter McDonald, sales department; A. L. Millard, sales department; C. A. Ross, sales department; H. B. Griffin, detail and supply department; Clarence Renshaw, engineering department. The Westinghouse Electric and Manufacturing Company distributed valuable memorandum books as souvenirs.

General Electric Company—J. B. Tingley, sales department; J. Scribner, manager lighting department; E. P. Edwards, sales department; S. F. Dibble, manager small motor department; F. N. Boyer, manager supply department; F. W. Hild, assistant engineer. The General Electric Company distributed as souvenirs miniature incandescent lamp scarf pins.

Fort Wayne Electric Works—C. E. Sedgwick, sales department; C. E. Searle, sales department; Walter S. Goll, manager Chicago office.

Duncan Electric Manufacturing Company—Thomas Duncan, vice-president and general manager; William H. Sinks, sales department.

Nernst Lamp Company—A. C. Wales, A. E. Fleming.

Holophane Glass Company—C. A. Howe, sales manager; H. E. Watson, sales department.

Reynolds-Dull Flasher Company—E. R. Dull.

Benjamin Electric Manufacturing Company—Syles R. Fralick, sales department.

Federal Electric Company—R. B. Francis, sales department.

Locke Insulator Manufacturing Company—J. S. Lapp, sales manager; W. T. Goddard, sales department.

Electric Storage Battery Company—G. H. Atkin.

Wagner Electric and Manufacturing Company—A. H. Timmerman, superintendent; E. K. Seymour, sales department; George R. Foster, district manager.

Andres & Sons Company—J. C. Schmidtbauer.

Daggett Trolley Company—W. F. Daggett, president.

C. F. Hamacek.

Northern Electrical Manufacturing pany, Madison, Wis.—T. F. Whitfield, Milwaukee manager.

Dearborn Electric Company, Chicago—Charles Messer.

Porter & Berg, Chicago—P. E. Davenport and Leon Bly.

Monarch Electric and Wire Company, Chicago—Samuel Markowitz.

National Conduit and Cable Company, New York—W. H. Pearl.

Macomber & Whythe Rope Company, Chicago—George S. Whythe.

Electrical Appliance Company, Chicago—William Low, president, and W. P. Upham.

Pass & Seymour, Solvay, N. Y.—Julian S. Jackson, sales agent.

Adams-Bagnall Electric Company, Cleveland—J. G. Pomeroy, western sales agent.

Laporte Electric Company, Laporte, Ind.—J. H. Harding, treasurer and superintendent.

Waclark Wire Company, Chicago—J. B. Wallace.

General Incandescent Arc Light Company, New York—Francis Raymond, western sales agent.

American Steel and Wire Company, Chicago—W. A. Garns, sales department.

American Circular Loom Company, Chelsea, Mass.—H. B. Kirkland, western manager.

H. T. Paiste Company, Philadelphia—James Wolff, western manager.

Stanley Electric Manufacturing Company Pittsfield, Mass.—Locke Etheridge, M. E. Edwin, L. Barr, western sales manager, and A. A. Morton.

Thomas G. Grier Company, Chicago—George A. Gray.

Spranley & Reed, New Orleans—W. T. Spranley.

American Diesel Engine Company, New York—Norman McCarty, general sales manager.

George Cutler Company, Chicago—George Cutler, president.

New York Insulated Wire Company, New York—James Wolff, western manager.

Standard Underground Cable Company, Chicago—E. J. Pietzcker.

M. B. Austin & Company, Chicago—Arnold H. Friend, sales agent.

Cutler Hammer Manufacturing Company, Milwaukee—A. W. Berresford, secretary; F. L. Pierce, treasurer; F. S. Wilhoyt, engineering department; C. L. Knight, engineering department; N. S. Hopkins, purchasing agent; J. T. Hawkins, advertising manager.

Central Construction Company, Oshkosh, Wis.—George F. Rohu, Milwaukee; L. E. Wolf.

Chicago Insulated Wire Company, Chicago—William M. Smith, secretary and treasurer.

Standard Underground Cable Company—J. R. Wiley, manager western sales department.

Henry Newgard & Company, Chicago—C. E. Browne, secretary.

On Thursday evening a supper and vaudeville smoker was given under the auspices of the association. It was largely attended and every one had a jolly good time. The affair took place at Mozart Hall.

Mexican Substitute for Rubber.

James A. Leroy, United States consul at Durango, Mexico, reports that a shrub called the guayule, which grows on the arid northern plateau of Mexico, renders an extract possessing the appearance and qualities of rubber. Nothing worthy of mention has hitherto been done with this plant, probably because sufficient attention has not been drawn to it, or because of failure to find a satisfactory process of extraction. Within the past two years, however, New York rubber manufacturers have developed a process for the utilization of the plant. Under the name of the Anglo-American Company they have obtained a concession from the state of Coahuila, and are about to build a factory for the extraction of rubber from the guayule at Torreon.

THE COMBINATION OF DUST DESTRUCTORS AND ELECTRICITY WORKS ECONOMICALLY CONSIDERED—III.[1]

BY W. P. ADAMS.

(Concluded.)

As the refuse is delivered it is tipped on to a platform above the cells and burned steadily throughout the twenty-four hours, no attempt being made to burn extra refuse during the peak. The delivery of refuse begins on Monday generally about 9 A. M., and ceases about midday Saturday. The destructor is generally entirely shut down from 11 P. M. on Saturday until the early hours of Monday morning; before the new refuse begins to come in, the cells are started on such refuse as was left over from Saturday. It has been the practice since the works started to weigh carefully the coal used on each shift, so the values of the refuse are readily obtainable on each shift. It will be seen from the diagram (Fig. 8) for Monday, December 15, 1902, that the day load is small, the early morning load large comparatively, and, of course, the peak shift the heaviest. On this day the cells were started at 1 A. M., and the greater part of the load was run on coal during the first shift; on the second shift no value appears to have been obtained from the refuse, as the coal works out at about nine pounds per unit generated; ten hundredweight of the coal, however, was used for

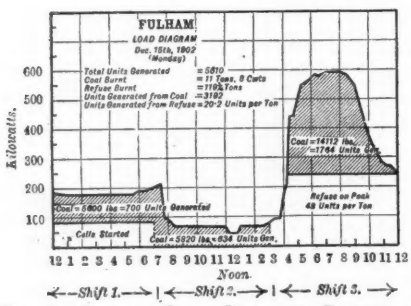


FIG. 8.—FULHAM LOAD DIAGRAM, DECEMBER 15, 1902.

banking, and no account is taken of steam supplied to the disinfector from 9.30 to 4.45. In all the curves no allowance is made for steam supplied to the disinfector, brick-making plant, etc., and the coal is worked out at eight pounds per unit throughout. On Mondays a poor value is obtained for the refuse, as the whole of the cells and flues have to be heated up from cold, and on Tuesdays full value does not usually seem to be obtained, although (Fig. 9) December 16, 1902, shows an almost record value. Bearing in mind the maximum of fifty-five units per ton obtained by Mr. Russell at Shoreditch on test, this figure of 91.5 units per ton is not a little remarkable, as it was obtained under ordinary working conditions, and until I drew out the curve such a result was not even suspected. I may say that most of the curves from Fulham were selected almost at random from the log-books, and had never been plotted before with the coal and refuse values filled in.

A second series of curves taken a year

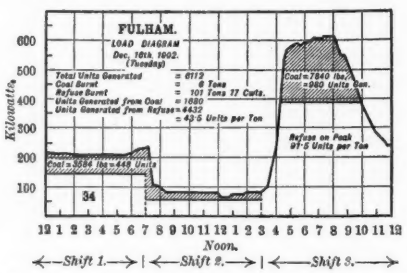


FIG. 9.—FULHAM LOAD DIAGRAM, DECEMBER 16, 1902.

later showed very similar results, but the highest value obtained on the peak is seventy-eight units per ton; the average value, however, is some five units per ton higher, notwithstanding the addition of the Bellis fan engine and of the brick-making and clinker plant. On both first and second shifts the load has largely increased, and a better value is obtained in consequence.

To bring the diagrams up to date I have prepared a series in January this year, and in these were found the best results; the average obtained for over three days—50.4 units per ton—is good, but the record value on the peak load of January 9 (Fig. 10) of ninety-four units per ton is very fine, and in view of the small day load an average for the day of 52.3 units is highly satisfactory. After studying these curves the first question that will be asked is, why, if such splendid results are obtained on the peak, are not better figures recorded on the two first shifts? Air leakages, I am given to understand, are largely responsible for this; troublesome cracks have been developed in the flues through the shrinkage of the soil upon which they are built, and, notwithstanding the care taken to make the destructor boiler fronts tight, considerable quantities of air pass into the flues, thus cooling the destructor gases. When the boilers are coal-fired this air is utilized in combustion in the usual way, and thus, the larger the load—*i. e.*, the more coal burned, the better the value obtained from the refuse. The air leakages are without doubt serious, and are engaging the attention of Mr. Fuller. In addition to this, a fairly large proportion of the coal is used for banking spare boilers; this would appear to be a necessity in an alternating station where a convenient battery is not available in case of necessity. In course of time, with a larger day and early morning load, I can see no reason why the fine values obtained on the peak load should not be maintained throughout the day, and, if it were at all possible to avoid shutting down on Sundays for cleaning purposes, throughout the week. Under existing conditions, but with a large day load, I consider that some seventy to eighty units per ton ought eventually to be obtained in winter and some fifty to sixty units in summer. In deference to Mr. Fuller's wishes, I have given in table B fifty-two units per ton as the ultimate all the year round average. As I have nothing at stake in the matter except perhaps my reputation as a prophet, I should have put the figures some twenty-five per cent higher; the average value obtained on the peak on the ten curves I have plotted is seventy-five, and this at the present high-water consumption.

During the year 1902-3 the clinker obtained was some fifty per cent of the refuse burned. Mr. Fuller tells me he has now reduced this to about one-third,

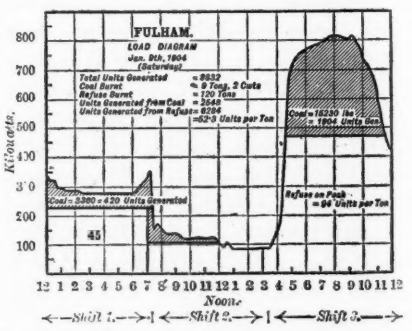


FIG. 10.—FULHAM LOAD DIAGRAM, JANUARY 9, 1904.

and sometimes he gets as little as twenty-eight per cent. This clinker is now being sold at a profit, so that on the present year's returns the rather heavy item for cost of disposal will disappear. The credit for electricity is about twenty per cent less than the ascertained coal value. The costs, after deducting revenue, amount to 26.3 pence per ton; this deficiency is met by a credit from the health department. The ultimate value of the steam based on the present coal costs amounts to about £5,000; it is probable that the cost of repairs will increase, but after making

[1] Abstract of a paper read before the Institution of Electrical Engineers, London, England, December 15, 1904. The former portion of the paper appeared in the ELECTRICAL REVIEW, January 7 and 21.

a reasonable allowance in this connection the figures would seem to justify one in concluding that when the full heat value of the refuse is utilized the Fulham destructor should earn a profit of approximately £1,000 a year after all costs of destruction have been paid. Such profit as results from the sale of clinker should be added. Fulham at present holds the record for lowest total costs of destruction in the London combined works.

Hackney—As already stated, I have taken great pains to ascertain the actual coal consumed per unit generated at Fulham, but as no regular record is kept of the water consumption, it may perhaps be suggested that I have taken too high a figure in basing my calculations on eight pounds. I am quite satisfied as to the correctness of this figure, but owing to the element of uncertainty, I turn with the greater pleasure to the Hackney records, for here the water is metered and the coal consumption is ascertained. In addition to this, the figures of the water and coal consumption are quite exceptionable.

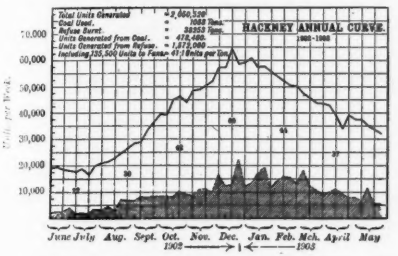


FIG. 11.—HACKNEY ANNUAL CURVE.

The electrical plant at Hackney consists of high-speed engines and direct-current generators, and an interesting feature is the 1,200-unit Tudor battery. The plant is run condensing, and thirty pounds of water are used per unit generated. The average coal consumption is about five pounds per unit generated. The Hughes & Stirling destructor consists of three four-cell groups, with a combustion chamber between each two pairs of cells. The combustion chambers lead direct to three Babcock boilers placed immediately behind the cells. The refuse is tipped into hoppers, from whence it is raised by elevators into three large bins above the cells; from these bins it is drawn as required and fed into the cells. The blast is provided by electrically driven fans, and is not heated.

The annual curve (Fig. 11) is not dissimilar from the Fulham; a better value, however, is obtained in the summer, and the Fulham record of fifty-three units per ton throughout the week is beaten by the Hackney sixty units per ton. The units per ton throughout the year amount to 41.1, as against the Fulham 27.8. It should be observed that the curves cover the same period—namely, from June, 1902, to May, 1903. The coal in this and all the Hackney curves is plotted in at five pounds per unit generated.

The chief interest lies in the Hackney day-load diagrams, for at present the day load is small and the peak value almost beyond belief. The method of burning the refuse differs slightly from that in use at Fulham, in that a varying number of cells is used when occasion requires. The refuse is, however, burned uniformly, without any attempt to force the cells during the hours of the heavy load. The rate of burning per cell-hour varies very little. The cells are shut down early on Sunday morning, when the refuse which has been collected during the week is exhausted, and started again on Monday morning as soon as the new supply of refuse begins to come in. On November 6, 1902—a Thursday, which is closing day at Hackney—the whole output was carried on refuse steam (Fig. 12). The highest value on the peak lasting about two hours amounted to no less than 104.3 units per ton. The rate of burning is shown at the base of the diagram. Eight cells were burning from 12 to 8 A. M., twelve cells onward to 10 P. M., and from ten to twelve eight cells. Although the refuse was being burned steadily, the generating plant was shut down from 6 A. M. to 1 P. M. The

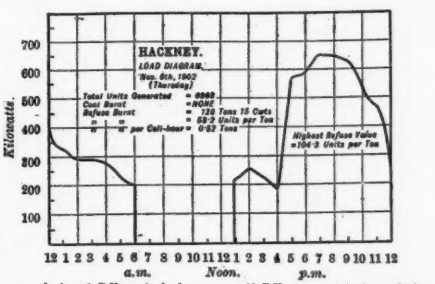


FIG. 12.—HACKNEY LOAD DIAGRAM, NOVEMBER 6, 1902.

three diagrams for December 16, 17 and 18, 1902, showed that the high value of 104 units per ton is not altogether exceptional, the average for the three days amounting to 102.1 units per ton. On each of these days the refuse was burned uniformly throughout in ten cells, and the generating plant was entirely shut down for four or five hours. The value obtained on December 17 of 105.8 units per ton on the peak load is the highest record which has come to my notice. I desire to repeat that these figures were obtained under ordinary working conditions, and without any one being aware that such fine results were being realized until the curves had been drawn out. Given a sufficiently large load such as that obtained at Shoreditch, there really seems to be no reason why 100 units per ton should not be reached throughout the day.

After observing the splendid value obtained on one of the Fulham curves, I

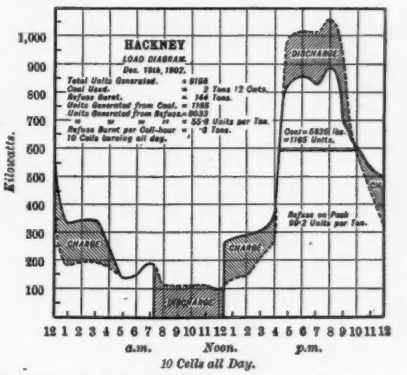


FIG. 13.—HACKNEY LOAD DIAGRAM, DECEMBER 18, 1902.

naturally anticipated better results would be found at Hackney, and, comparing the relative water consumption, if ninety units per ton is obtained at Fulham, 120 or even more ought not to be an impossible figure at Hackney. Air leakages are, I believe, not unknown at these works, and may, perhaps, account for reduced efficiency.

I have thought that a diagram showing the value of the large battery at Hackney might be useful. The diagram of December 18, 1902 (Fig. 13), gives the total load on the station, including feeder output. The solid line gives units generated, and the dotted line the station output. The battery charge and discharge are indicated by the shaded portions, on the top of the peak the average load taken is about 160 kilowatts and the maximum 220 kilowatts; roughly, the discharge on the top of the peak represents 600 units, about half the nominal capacity of the battery. Had the full capacity of the battery been utilized the load carried on the peak would have been 250 kilowatts, and a very small quantity of coal would have been required. As it is the diagram shows that about forty per cent of the coal which would be necessary without the battery has been saved.

A reference to table B will show that for the year ending March, 1903, some thirty-seven units per ton of refuse were generated after deducting the electricity used in the fan motors. As the average of steam-raising value is put at eleven pounds per pound all the year round, and the water evaporated during the last financial

year was only 0.54 pound per pound, it seems fairly safe to assume that an average figure of sixty-four units per ton will be obtained ultimately. Personally, I shall be surprised if in the course of a few years this figure is not considerably exceeded. In this connection it is not a little interesting to note that a value of 105 units per ton at thirty pounds of water per unit means an evaporation of 1.4 pounds of water per pound of refuse.

The destructor costs for the last financial year are high; the wages correspond curiously with those at Fulham, the clinker disposal formed a considerable item of expense, and as the destructor was running only eleven months during the year, the capital charges per ton were heavier than will be the case in future. The credit to the destructor for electricity is based on the coal cost, and is therefore absolutely fair. As in the case of Fulham, the difference between the destructor revenue and total costs—namely, 35.4 pence per ton destroyed, is met by a credit from the health department. Owing to the Hackney destructor having a less favorable market for its steam, it does not seem likely it will earn a profit as will probably be the case at Fulham.

Bermondsey—The smallest of the London combined stations has successfully completed a year of working. The returns, however, have not yet been published, and at the time of writing are not available. Mr. Vincent has, however, kindly placed at my disposal information which will prove of interest. The plant consists of high-speed vertical engines with direct-current generators; no use is made of the exhaust steam. The battery is small, being of only 240 units capacity. The Hughes & Stirling destructor consists of three pairs of cells with three Babcock boilers. A combustion chamber is provided between each pair, which leads into a flue at the back of the cells and so to the boilers. This arrangement is not quite so favorable as that at Hackney. The blast is provided by electrically driven fans, which only take six per cent of the total quantity of electricity generated. In addition to supplying steam to the electric generators a supply is given to the adjoining baths and washhouses. The coal bill at the baths before the erection of the destructor was between £400 and £500 per annum; two stokers were also employed whose wages amounted to about £150 a year. The coal burned at the electricity works was only 400 tons for the year; thus, altogether apart from the electricity works, a saving of about £600 less £380—the value of the coal—has been effected by the introduction of the destructor. It will thus be seen that the whole of the electricity generated may be credited to the refuse. After deducting the units used by fan motors, the very creditable figure of 29.8 units has been obtained per ton of refuse, a figure second only to Hackney. On the official test the fine value of 1.65 pounds of water was obtained per pound of refuse, and, in view of the high calorific value of the Bermondsey refuse, Mr. Vincent anticipates that some eighty-six units per ton is the ultimate value of the refuse. The credit given to the destructor of one penny per unit generated, or 1.09 pence per unit sold, is undoubtedly high, but the works are unfavorably situated, the price of coal is high and condensing is impossible. Compared, therefore, with the average for the six uncombined London undertakings of 0.93 penny, the figure is not so extravagant as would appear at first sight. In view of the high coal value, the Bermondsey destructor should earn a substantial profit when the full heat value of the refuse is utilized.

Woolwich—The combined electricity and destructor works here have so recently been added to the list of metropolitan undertakings that returns for a year of working are not available. I am able, however, to give the result of an excellent test taken early this year. With a water consumption of forty pounds per unit generated, the fine figure of 100 units per ton was generated for two hours continuously. With the same economical plant as at Hackney this figure would have been 133 units per ton. If Mr. Mitchell can bring his water consumption down he may yet beat all records. The destructor is a Meldrum Brothers "Simplex."

PROVINCIAL UNDERTAKINGS.

Wimbledon—From the figures given to me by Mr. Tomlinson Lee it is plain that these works should not be included in the list of combined undertakings. The joint works adjoins the sewage works, and the whole of the steam available from the refuse is used for sewage pumping and heating the hospital some 600 yards away from the works. The coal saved to the sewage works amounts to £900 a year, and Mr. Lee states that beyond what the destructor can do he provides coal-generated steam to the value of about £5 per annum in addition; this being so, the value of the steam in terms of possible units of electricity generated can only be estimated. On the basis of the present coal cost—namely, 0.9 penny per unit sold—the units generated would amount to 300,000. From another source I understand that it has been estimated at forty-five units per ton. Taking the former figure, thirty-three units per ton is a highly creditable performance, seeing that the refuse is burned with pressed sewage sludge in the proportion of one ton of sludge to two tons of refuse. The large percentage of moisture and the very small percentage of combustible matter in sludge are well known. The furnaces are of the Beaman & Deas type, with Babcock boilers.

Grays—Through the courtesy of Mr. Long and Mr. Arthur Preece I have been provided with very full information regarding these works, and although the quantity of refuse burned is exceedingly small compared with the large works we have been considering, the results obtained are valuable. The generating plant is of the usual type, vertical high-speed engines with direct-current generators. The battery is double-pole of 160 units capacity. The plant is run non-condensing. The destructor is a two-cell Meldrum "Simplex," with a Lancashire boiler which is usually short. An economizer is in use, and also a regenerator in conjunction with steam blast. During 1902 the coal consumption per unit generated as ascertained by Mr. Long when the destructor has not been at work was nine pounds in the winter and ten pounds in the summer. The average for the year works out at 9.5 pounds. The total coal used during the year was 348 tons, a large proportion of which was used in getting up steam to assist the destructor for a short time every day. The resulting fifteen units per ton of refuse is poor, but it is clear that as the load increases a better value will be obtained. Returns for the year ending March, 1903, have reached me, and a substantial improvement is already manifest. Allowing for the reduced consumption of nine pounds of coal per unit, the average units per ton of refuse is increased to twenty-one. The ultimate value with the plant working under more favorable conditions should reach thirty units per ton. In a small plant of this description burning between 2,000 and 3,000 tons per annum, the economical utilization of the refuse becomes quite a special study, and the burning of coke breeze or coal in the destructor furnace to assist in the event of a shortage of refuse would probably prove more economical than getting up steam in an independent boiler. It is not possible to mix good fuel with the refuse, but with a little trouble a portion of the grate can be separately utilized. It is, I understand, now Mr. Long's practice to burn

coke breeze in the furnace in this manner.

Gloucester—The type of destructor in use in this town is that constructed by Messrs. Heenan & Froude. The plant is a comparatively small one, consisting of two cells only, with one Babcock boiler. An economizer is used, and also a regenerator in conjunction with the fan-blast, the fan being driven by electric motors. The engines are vertical, high-speed condensing, the generators direct current, and an E. P. S. battery of 440 units capacity is in use. In recording the returns for the year 1902-3, I have had difficulty in apportioning the units generated between coal and refuse; Mr. Bache, the engineer, informs me that the usual rate of burning is one ton per hour, but on the peak the rate is increased to from twenty-five hundredweight to twenty-eight hundredweight. He states that 100 kilowatts to 120 kilowatts was maintained for one hour. From twenty-five to forty units per ton are obtained in summer and from sixty to eighty in winter. When all the refuse is burned usefully, it is expected that an average of eighty-six units per ton will be obtained; at present the day load is small. In dividing the units generated for the year between the coal and refuse, I have had to assume that fifteen pounds of coal were burned per unit generated. The refuse-generated units on this basis work out at one-third of the estimated total possible. Messrs. Heenan & Froude inform me that at present one-third of the refuse is burned usefully.

Christchurch, N. Z.—One other plant I must mention briefly, as it has the distinction of being the only combined works outside the United Kingdom. The installation at Christchurch, New Zealand, has just completed its first year of working, and when the returns are published shortly, excellent results are promised. The electrical equipment is the usual high-speed, direct-current type, but the battery is large, being half the size of that at Hackney—namely, 600 units. As an advocate of large batteries in combined works, I look forward with special interest to the publication of particulars, for the total capacity of the generators installed is only 200 kilowatts. The destructor is of the Beaman & Deas type, consisting of two pairs of cells and two Babcock boilers, erected by Messrs. Meldrum Brothers in 1902. Twenty-five tons of refuse are destroyed between the hours of 8 A. M. and 10 P. M., giving ample steam for supplying the load during these hours and for charging the battery; the generators are shut down the rest of the day. The average evaporation is given at 2,000 pounds of steam per ton of refuse.

Enough has already been said to show that under statisfactory conditions excellent results may be obtained from the combination of refuse destructors with electricity works. The installations at St. Helens and Shipley have been described by Mr. Highfield and Mr. Schofield, respectively, and between thirty and forty units per ton are obtained on the average. In a recent letter, Mr. Schofield informed me that he anticipates that some fifty units per ton will eventually be realized. At Partick, 29.6 units per ton were realized during last year, and it is anticipated that thirty-seven units will ultimately be obtained. Although I have not obtained much data from Garston, the figures supplied show that some fifty to sixty units per ton are frequently obtained, and particulars of a test lasting eighteen hours with the generating plant run non-condensing show an average of sixty-two units per ton, the water consumption being fifty pounds per unit generated.

In endeavoring to secure good steam-raising results, it is desirable to maintain the temperature of the flues as uniformly as possible, and any device therefor which will render the shutting down of the plant for cleaning purposes unnecessary will be valuable. Particularly is this so in small plants, and the apparatus devised by Mr. Sillery, of Wrexham, is a step in the right direction. By means of this apparatus the dust destructor at Wrexham has been kept running for a whole year without a break. The maintenance of the temperature in the flues is important, not only from a steam-raising point of view, but also is desirable as tending to reduce the expenditure on repairs. The constant expansion and contraction of the brickwork owing to alternate heating and cooling is destructive.

As points deserving of careful attention, I have already referred to air leakages and the method of producing the blast. Both of these may be sources of large percentages of waste. Another point to which I have referred, and which it may be well to emphasize, is the possible loss of efficiency due to long and badly arranged flues. Mr. Price F. White, of Bangor, has been most kind in providing me with information concerning his plant, and in explanation of the poor results obtained calls my attention to the construction of the main flue. It is important to note that the destructor was added after the electricity works had been put down, and the main flue from the destructor to the boiler house is long and built at a low level. The result is that the flue is very damp, and the greater part of the evaporation due to the destructor gases takes place outside the boiler. At times, Mr. White informs me, the flue is so full of water that the destructor has to be shut down.

A large proportion of total costs is often caused in disposing of the clinker. This matter is one requiring serious consideration, as if a satisfactory sale for this destructor by-product can be secured, a heavy annual cost will be turned into a substantial profit. As an illustration of this I may point to the fact that at Fulham the cost of disposal of clinker amounted to £479. Mr. Fuller is making special efforts to dispose of his clinker profitably, and this year the loss will have disappeared and a profit has been secured instead. At Hackney, Mr. Robinson is not quite so successful, but he is now disposing of the clinker without cost. This will result in a saving of £750—no mean proportion of the total costs of destruction last year.

So long ago as 1892, Professor George Forbes stated in a lecture before the Society of Arts that if the refuse then collected in Paddington were properly burned and used in the most economical way, it should provide enough electricity to light one eight-candle-power lamp for two hours every night of the year per head of the population, which is the estimated amount of light demanded by the exigencies of modern civilization. It is a great pleasure to me to take upon myself the vindication of Professor Forbes as a prophet, for by the exercise of a small amount of scientific license, I am able to demonstrate that in at least two metropolitan boroughs this result will certainly be achieved within a few years. A thirty-watt carbon lamp burning two hours per night throughout the year would absorb twenty-two units. A Nernst lamp giving the same light would burn, say, eleven units. The population of Fulham is 150,000, thus 1,650,000 units would be required; the ultimate value is estimated at 1,870,000 units. The population of Hackney is 230,000, the units required would amount to 2,530,000; the ultimate value of the Hackney refuse as estimated by Mr. Robinson is 2,436,000 units.

I will ask you to bear with me while I make a modest little calculation on my own responsibility. The annual collection of refuse in London amounts to approximately 1,250,000 tons; taking so low an average as forty units per ton as

its potential capacity for generating electricity, no less a sum than £200,000 per annum—taking the average coal cost of all the London undertakings—is being tipped on dust heaps, resolved into vapor and deliberately barged out to sea at a heavy cost.

Conclusions—As I am addressing engineers, I need summarize my conclusions but briefly.

1. The remarkable figures obtained in some undertakings as demonstrated in the series of curves I have had the privilege of laying before you, are evidence that great advances have been made in the problem of utilizing waste heat from burning refuse in destructors since the pioneer works were started.

2. That these results still leave room for substantial improvement—(*a*) By closer attention to the details of construction of furnaces and flues and the general arrangement of the plant; (*b*) by improving the methods of handling and burning the refuse; (*c*) by careful utilization of the steam generated and the adoption of an economical form of blast.

3. That, given suitable conditions, there is without doubt a substantial gain to be effected by the combination of electricity and destructor works; but owing to the variation in the calorific value of refuse in different localities, and to other special local considerations, every proposed case of combination needs to be considered on its merits by persons qualified to make an independent and intelligent enquiry.

4. That the various and in some cases crude methods in vogue of adjusting accounts between the two works need to be systematized, and that it is highly desirable that the results obtained be separated and recorded with accuracy, so as to give, so far as possible, a true record of the financial position of both works.

Mineral Resources of the United States.

The United States Geological Survey, Department of the Interior, Washington, D. C., issued two bulletins recently. One deals with the stone industry, and contains nothing of interest to electrical industries. The other, however, is of considerable interest to these industries. This is a statistical examination of the production of minerals in the United States during 1903, and compares the business of this year with preceding years.

After giving a brief general summary of the year's business, the iron production is taken up, but there is no attempt to show what bearing the electrical industries have upon this trade.

Copper, however, stands in an important relation to the electrical trades, and it is interesting to notice how the production of this metal has increased since the introduction of the telephone, electric lighting, the electric railway and power transmission, growing from an annual production of 19,000 long tons in 1876—the year when the invention of the telephone was announced—to 311,627 tons for the year covered by the report. Of this total production, twenty-seven and one-half per cent is from the Lake Superior mines, twenty-eight and nine-tenths per cent from Montana, and twenty-one and one-tenth per cent from Arizona.

Lead is another metal which is very useful to the electrical engineer, but the report gives no means of determining how much this material was used in the manufacture of accumulators and sheathing of cables during 1903. The total production was 280,000 short tons.

The production of aluminum is of particular interest, since not only is this entirely produced electrically, but the chief use is for electrical conductors, and the report states in this it is still expanding in this country. It is said that during the year, among many others, two contracts were reported, one for 500,000 pounds, and one for 298,245 pounds of aluminum wire. Drawn wire seems to be more susceptible to corrosion by atmospheric action than rods, and to counteract this disadvantage, manufacturers are now putting on the market a so-called weather-proof wire, which is coated with a preparation that forms a thorough protection for the metal. To overcome the difficulty encountered in soldering aluminum conducting wire, a patent was taken out in 1903 by Nicholson, by which a compound ingot of copper and aluminum is drawn into a wire having a copper core and an aluminum cover. The core of copper may be readily soldered without raising the resistance of the joint.

The production of aluminum in this country became important only after the electric furnace was put to commercial use. For instance, in 1883 the total quantity produced was only eighty-two pounds. In 1886 it jumped to 3,000 pounds, and then increased rapidly to 61,281 pounds in 1890. The following year the output was 150,000 pounds, and since then it has increased rapidly until the last few years, when it has remained fairly steady, the estimated output for 1903 being 7,500,000 pounds.

Steel-hardening metals are not of much interest to us, except possibly tungsten, which is used in the production of permanent magnets for checking instruments, because of the high retentivity which it confers upon the steel. Some of the other metals of this group have a secondary interest, since the study of them has had an important bearing upon electrical science. Among these is uranium.

The coal industry touches the electrical industry in two ways, because it is our main reliance for the production of electrical power, and for the important part which electrical apparatus is taking in the mining of this commodity. The total production of coal in 1903 was 357,356,116 short tons—a little less than 1,000,000 tons per day, and practically all of this was consumed in this country. Of this total consumption, that used in electrical generating stations was but a few per cent. It is interesting to compare the production of this country with that of the entire world, which was 967,857,406 short tons, this country producing thirty-seven per cent of the total. The countries coming next are Great Britain and Germany. Of the total production of coal, 77,974,894 short tons, or 21.8 per cent, was machine-mined.

The production of petroleum for 1903 was 100,461,337 barrels of forty-two gallons each, an increase of over eleven per cent over the previous year. The total production for the world was 165,773,361 barrels. During the year there were produced, in addition, 238,769,067,000 cubic feet of natural gas at atmospheric pressure. This represents approximately 5,968,000 tons.

Under the heading of abrasive materials we find carborundum listed, the production for the year being 4,759,890 pounds, an increase of over twenty-one per cent over the previous year. The output of artificial graphite for the year was 2,620,000 pounds—the largest quantity produced in any year, and an increase of ten per cent over that of the previous year. The production of natural graphite was 4,538,155 pounds. These two, however, supplied but a part of the total market, as there were over 16,000 long tons of graphite imported during the year.

Among the rarer minerals mined are monazite and zircon, which are valued for the rare earth oxides which they contain. These oxides are used in the manufacture of mantles for incandescent gas lamps and for glowers for the Nernst lamps. The demand for monazite is increasing, although there is not a large increase in

the yearly production. The demand for zircon is small. The value of monazite is due to the presence of a small percentage of thoria. The commercial mineral contains from three to nine per cent of this oxide, with small amounts of other valuable oxides, which are used to a limited extent in other industries. The commercial deposits of these minerals lie in North Carolina and South Carolina, where mining is carried on on a very small scale—frequently by children. Monazite is not obtained from the original rocks, but in the gravel deposits of present and former streams which have resulted from a disintegration and erosion of the crystalline rocks containing monazite. These gravels are worked over by means of sluice boxes, and the value of a deposit depends greatly upon the available supply of water. After the gravel has been worked over once it can be reworked, since by that time it has accumulated a sufficient quantity of fresh deposit to make it pay.

Under the heading of clay-working industries, we find that the value of the pottery products for the year was over $16,000,000. Of this total, $1,464,980 represents the value of the porcelain electrical supplies. The production of glassware is shown, but no reference is made to its use in the electrical trades.

The production of mica for the year was valued at a little over $59,000—a little less than half the value of the production for the previous year.

Annual Convention of the South Dakota Telephone Association.

The annual convention of the South Dakota Telephone Association was held at Sioux Falls, S. D., January 11 and 12, 1905. Fifty towns were represented by delegates, and the convention was very successful. A number of papers was read, among them being two which were presented by H. J. Minhennick, of Sioux City, and by I. J. Kusel, of Chicago. The papers were entitled, respectively, "Cable Construction and Electrical Engineering as Applied to Telephony," and "Automatic Apparatus and Its Relation to the Manual, and Vice Versa." The convention was closed by a banquet at the Cataract Hotel.

The Wagner Electric Manufacturing Company.

The directors of the Wagner Electric Manufacturing Company, St. Louis, Mo., met on the evening of January 23, and elected the following officers: S. M. Dodd, president; J. W. Bell, vice-president; A. Blair, secretary; W. A. Layman, treasurer and general manager.

The directors voted a quarterly dividend of one and three-fourths per cent. It is expected that the business for 1905 will show a large increase over that secured in 1904.

The Independent Telephone Association of Nebraska.

Representatives of the principal independent telephone systems of the state of Nebraska met on the afternoons of January 18 and 19, at Lincoln, Neb., and discussed plans for the formation of a state organization and the improving of service throughout the state. A committee of five members was appointed to consider plans for a clearing-house for the purpose of distributing to each system its share of money received for long-distance tolls. This committee consisted of J. C. Killarney, Auburn; F. E. Ebersole, Lincoln; G. T. Everett, Columbus; W. C. Bell, York; T. H. Pollock, Plattsmouth.

Considerable discussion was indulged in concerning the best methods of standardization. It was the general sentiment that some standard should be adopted for the construction and operation of lines, particularly those systems which were intercommunicating. A committee was appointed to take this matter into consideration. This committee included F. E. Ebersole, O. M. Thorpe, of Wahoo; W. C. Bell, A. N. Munn, of Nebraska City, and T. H. Pollock.

A communication was read from the National Telephone Association, suggesting affiliation with that body. This matter was taken under discussion, and will be reported upon at the next meeting.

On Thursday, January 19, the chief topic of the morning's discussion was the eligibility of certain members of the association. It was decided to restrict the membership of the association exclusively to those persons who are engaged only in the independent telephone business.

Following this discussion, the nominating committee reported the following selections for officers for the ensuing year: president, W. C. Bell, York; vice-president, C. J. Garlow, Columbus; secretary-treasurer, G. T. Everett, Columbus.

The committee appointed to consider the matter of a clearing-house reported favorably, and was continued so that a fuller report might be made some time in March.

The committee appointed to consider the matter of standardization requested more time, and will submit a full report to the executive board.

The state association is strongly in favor of affiliating with the national organization of independent telephone companies. The constitution of the Pennsylvania Independent Telephone Association was read and referred to a committee composed of Messrs. Ebersole, Clark and Hansen, to report with recommendations as to changes that would benefit the Nebraska association.

Among the exhibitors at this convention were the following: Automatic Electric Company, Chicago; Frank B. Cook, Chicago; Kellogg Switchboard and Supply Company, Chicago; Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y.; American Electric Telephone Company, Chicago; Chicago Telephone Supply Company, Chicago; Kusel & Kusel, Chicago; Western Electric Company, Chicago; Monarch Telephone Manufacturing Company, Chicago; John A. Roebling's Sons Company, New York; Standard Underground Cable Company, New York; Swedish-American Telephone Company, Chicago; American Electric Fuse Company, Chicago; Wesco Supply Company, St. Louis, Mo.; Vought-Berger Electric Company, La Crosse, Wis.; National Conduit and Cable Company, New York; Nebraska Electrical Company, Lincoln, Neb.

The Institute Annual Dinner.

The annual dinner of the American Institute of Electrical Engineers will be given in the ballroom of the Waldorf-Astoria, New York city, February 8, 1905. This promises to be a most interesting occasion. The committee has decided to devote this dinner to emphasizing the triumphs of electric traction. An original menu has been arranged, and some novel features will be introduced. A number of pioneers in electric traction and present-day leaders will be among the speakers. The dinner will be served for $5 per cover, without wine or cigars.

The following special committee has been appointed to make arrangements for this annual dinner: T. C. Martin, chairman; F. C. Bates, H. W. Blake, P. G. Gossler, W. C. Gotshall, E. B. Katte, F. B. H. Paine, Charles W. Price, Calvin W. Rice, L. B. Stillwell, H. G. Stott and Arthur Williams.

Death of Mr. Ernest H. Mullin.

Mr. Ernest H. Mullin, manager of the advertising department of the General Electric Company, with offices at 44 Broad street, New York city, died on January 25, of heart disease. The news of Mr. Mullin's death will be received with great sorrow. He was one of the most widely known men in the electrical fraternity. He was a member of many electrical organizations and an indefatigable worker for the upbuilding of the American Institute of Electrical Engineers, of which organization he was, at the time of his death, a manager. Funeral services will be held at his home, Milburn, N. J., on Saturday, January 28.

The Installation of a Transmission Plant.

In the *Electric Club Journal* for January, 1905, an interesting article entitled "The Installation of a Transmission Plant," by "A Road Engineer," presents an amusing and instructive account of some early installation troubles. Among other trials which the engineer endured were those of bringing into working shape a pair of balky rotary converters. The following is an abstract from this article:

"This particular plant was laid out for three 750-kilowatt generators, but only two were to be installed. They were sixty-cycle three-bearing machines arranged to have an impact water-wheel mounted on the shaft just where a pulley would be placed if the machine were to be used with a belt-drive. Two exciters were furnished, each mounted with a water-wheel similarly to the generators. A switchboard, two banks of two-phase three-phase transformers for stepping up to 15,000 volts, some high-tension bayonet switches and type R lightning arresters completed the power-house equipment. The transmission was thirteen miles and at the receiving end were two 400-kilowatt, 550-volt, eighteen-pole, rotary converters. These converters were the largest that had yet been built for sixty cycles.

"The rotary converter, on account of the type, naturally required considerable attention and some experimentation to get into satisfactory service. One of the characteristics of these machines, which occasioned special treatment, was the high commutator speed, which greatly increased the influence of surface roughness upon the commutator. The combination of high speed and roughness caused the brushes to vibrate, which resulted in rather poor contact between them and the commutator. Of course sparking took place. If the commutator was neglected, the sparking would accentuate the roughness of the commutator and this increased roughness would further aggravate the sparking, so that the sparking would increase at an accelerating rate until the machine would finally buck. This with a uniform load, while all other conditions were good. The cause was not fully understood at the time and it was thought to be chiefly in the setting of the brushes. After a short experience with this machine it was discovered that a smoothness sufficient for slow-speed commutation might not be sufficient at a high surface velocity. Although the commutator might feel smooth to the finger, if the end of a lead pencil was pressed against the back of a brush, a good deal of vibration might be felt. In overcoming this, it was found quite advantageous to support a piece of a grindstone on a properly constructed rest and crowd it against the commutator, while running with the starting motor. This was persisted in until a fresh surface was obtained. After following this up with a very fine sandpaper, a surface was got which caused no perceptible vibration of the brushes.

"A further aid to smooth running was obtained by saturating the brushes with cylinder oil. Two sets of brushes were fitted to each machine, and while one set was in operation the other was immersed in oil. After receiving the above treatment, a machine would commutate perfectly for a very considerable period of time. After this a few hours' work would be required to put it in shape again.

"When first put into commission these rotary converters pumped quite badly and no adjustments of their fields would materially improve them in this respect. After some correspondence with the manufacturing company instructions were sent out to me to bore out the fields for a larger air-gap and bevel the pole corners. The boring out of the fields was somewhat of a puzzler at first as the machines were too large to be handled by any machine shop in that territory. After a time a boring bar was located that had been used to bore out the cylinder of a medium-sized Corliss engine. This bar was mounted in the bearings of a rotary converter after having been reconstructed to bore a sufficiently large diameter. It was belted to the end of the shaft of the other rotary converter which was carrying the railway load. This belt was necessarily small and ran at such a slow speed that it would not transmit power enough to pull the cutting tool through more than a very fine cut, but by taking a large number of cuts the bore was increased to the required amount. While this was being done the manufacturing company sent out two sets of copper dampers to be tried on the pole-pieces. One of these sets consisted of sheets of copper bent to the curvature of the pole-face and each made to completely cover one pole-face. The edges of each sheet were bent up an inch or so all the way around to secure it to the side of the pole-piece.

"As soon as the above changes had been made on one machine it was brought up to speed by the starting motor and the field was built up. Before, however, the field attained full strength, the machine commenced to make an ominous noise and slowed down. On investigation it was found that the copper facings on the poles had bulged out against the armature and were actually acting as brakes on the armature core. The armature being of the open-slot type, its teeth caused the magnetic flux in the air-gap to gather in tufts, and as these tufts followed the teeth across the pole-faces, they generated such excessive currents in the copper plates that the latter were discolored by heat and pulled out of position by the magnetic action of the induced currents. This difficulty was so great that these dampers could not be used at all. Their action is now well understood and with partially closed slots they make an effective damper. The other set of dampers was made of rectangular bars of copper surrounding the pole-pieces near the tips. Their use and the change in air-gap and beveling of the pole corners, resulted in decreasing the pumping to an unobjectionable amount."

Kern River Power Plant Started Up.

The power plant of the Kern River Power Company was started on December 30, 1904. The plant is located about 120 miles from Los Angeles, Cal., and has just been completed at a cost of about $2,000,000. It will furnish about 15,000 horse-power.

American Institute of Electrical Engineers.

ASSOCIATES ELECTED AT DIRECTORS' MEETING, NEW YORK, FRIDAY, DECEMBER 23, 1904.

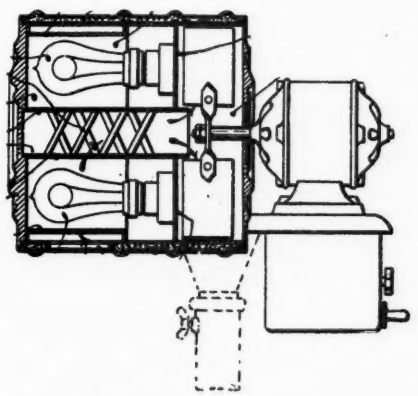
Charles V. Allen, Orange, N. J.
Robert Jamieson Browne, Calcutta, India.
John Shepherd Cowgill, Three Rivers, Mich.
Orville Hiram Ensign, Los Angeles, Cal.
William Craig Forsythe, Tallahassee, Fla.
Francis Perry Foster, Corning, N. Y.
Charles S. Hamner, Schenectady, N. Y.
John Steele Henderson, Wilkinsburg, Pa.
James Heywood, Philadelphia, Pa.
James Kent, Boston, Mass.
Fred Hutton Kroger, Boulder, Col.
Homer McCullough, Sheridan, Mont.
Domingo L. Monjo, Elizabeth, N. J.
Augustus Julius Pahl, San Francisco, Cal.
Henry Waterman Peck, Pittsburg, Pa.
William G. T. Pope, Lisbon, Portugal.
Henry Albert Pressey, Washington, D. C.
Norman Rowe, Guanajuato, Mexico.
Pierre V. C. See, Chicago, Ill.
Adolph Shane, Ames, Iowa.
Hans Christian Specht, East Pittsburg, Pa.
Alexander S. Spiegel, Chicago, Ill.
Frederick Starr Stitt, New York city.
William Maurice Talbot, Havana, Cuba.
John Rutledge Williams, Birmingham, Ala.
Roscoe Woltz, Lynn, Mass.
Walter Wood, Philadelphia, Pa.

TRANSFERRED FROM ASSOCIATE TO MEMBER.

Sidney R. Sheldon, Moscow, Ida.

Electrical Patents.

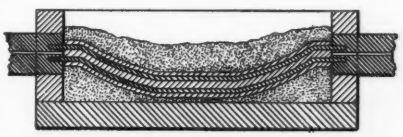
The hair driers now generally used for drying damp hair are mostly so constructed that the air heated by gas, spirits or otherwise is conveyed to the hair by means of fans or ventilators, and the very hot air rapidly produces a dry and undulated hair. These heating devices have in addition to others the drawback that the gas and spirit cause an unpleasant smell and make the air too dry, and further, that the heating can not be sufficiently regulated. Moreover, gas can not be used in places where there are no gasworks, but, as is frequently the case nowadays, electric light plants. A hair-drying apparatus patented (778,888, January 3, 1905) in this country by Otto Peter and Herbert von Kempski Ràcoszyn, of Osnabrück, Germany, obviates the above noted objections by providing an air warmer, which by means of electric lamps heats the air so rapidly and strongly that the hair drier is at once ready for use. This air warmer is easy to handle, causes no unpleasant



HAIR-DRYING APPARATUS.

smell, dries the hair thoroughly, and may be used with absolute safety. The invention consists of two concentric cylinders each provided with an orifice, a cover closing both of these cylinders at one end. A ring-shaped cover closes the space between the two cylinders at the other end, and in the ring-shaped space between the cylinders is arranged a plurality of glow lamps. A ventilator is at the open end of the inner cylinder, and means are employed for driving this cylinder whereby cold air is drawn into the outer cylinder, is heated by the lamps, and is drawn through the inner cylinder. Means are also provided for applying this heated air to the hair.

An improvement in the manipulation of refractory material is the subject matter of a patent (778,286, December 27, 1904) recently granted to Elihu Thomson, of Swampscott, Mass., and assigned to the General Electric Company. The invention relates to the formation of articles such as tubes, plates, or more complex forms, out of refractory material such as fused silica. In carrying out the invention a refractory conductor is provided, such as carbon, arranged to be traversed by a heavy electric current and adapted

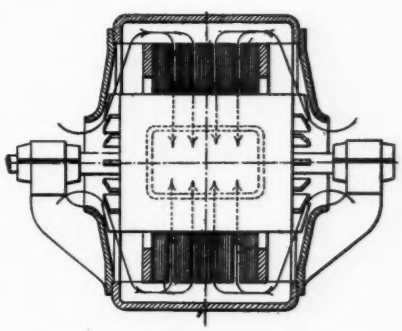


MANIPULATION OF REFRACTORY MATERIAL.

to be embedded in or surrounded by quartz granules or silica in comminuted form. Upon the passage of very strong heating currents through the carbon conductor, the quartz or other refractory material in the immediate vicinity of the conductor is melted, so that upon the cooling of the conductor a body of fused quartz following the contour of the conductor is formed. By choosing the size and shape of the conductor, it is possible to produce articles of fused quartz in a large variety of configurations.

Charles J. Reed, of Philadelphia, Pa., has assigned to Security Investment Company, of Pennsylvania, a patent (778,894, January 3, 1905) recently granted to him on a process of making spongy lead for secondary battery electrodes. The object of the invention is to provide an easily practised and inexpensive process for making finely divided lead, without electrolytic action, and therefore one which will consume a comparatively small amount of time and in which scrap or waste materials may be advantageously utilized. In practising the invention, one or more compounds of lead are mixed in a powdered condition, such, for instance, as oxide chloride, or sulphate of lead, with finely divided metallic zinc or zinc dust in chemically equivalent proportions. This powder when thoroughly mixed is subjected to a liquid of such composition as will decompose the lead compound into metallic lead and oxygen, chlorine, or sulphuric acid, according to the particular lead compound employed. The oxygen, chlorine or sulphuric acid unites with the zinc to form a zinc salt that is easily washed out by means of water, leaving pure metallic lead in a spongy form. Among the materials which may be utilized in practising the process are red lead and zinc dust in chemically equivalent proportions and a solution of zinc chloride. The mixture of powdered materials may be treated with the solution while in loose form to produce the finely divided lead for subsequent application to a suitable electrode plate or frame, or the mixture of powdered materals may be slightly dampened and applied to the plate or frame as a solid coherent mass, then dried out sufficiently to make it suitably absorbent, then subjected to the reducing liquid until the composition has been completely converted into metallic lead and a zinc salt, and finally subjected to a water bath for a sufficient length of time to remove the zinc salt. The plate thus formed is ready for use in a secondary battery.

An improvement in means for ventilating electrical machines has been patented (778,834, January 3, 1905) in this country by Albert Aichele, of Baden, Switzerland, who has assigned his patent



MEANS FOR VENTILATING ELECTRICAL MACHINE.

to the firm of Actiengesellschaft Brown, Boveri & Company of the same place. The invention relates to dynamo-electric machines, and more particularly to means for cooling the stator and rotor of such machines. Broadly speaking, the invention consists in the combination, with the stator and rotor, of an enclosing casing provided with an air-outlet and of means to establish a forced circulation of air through the casing from a point about the axis of the rotor to the periphery of the stator, thence between the coils of the latter to and about the rotor, and back between the coils of the stator into the casing of its air-outlet. The means for establishing the described circulation may be varied without departing from the spirit of the invention.

Reviews of Current Engineering and Scientific Literature.

An Electrical Speed Indicator.

The following interesting speed indicator has been devised by the firm of Siemens & Halske, Berlin. It consists of two parts: a small generator driven by the device, the speed of which is to be obtained, and an indicating device which may be placed at any convenient point. The first of these parts is merely a small inductor alternator. The stationary part is built up of stampings having inwardly projecting poles. The alternate ones are wound to form the field poles, and the others the armature poles. The indicator is driven from the shaft by a belt or in any suitable way. It sets up in the armature coils single-phase currents which are carried to the indicating instrument. This consists of a four-pole magnet, wound so as to produce a rotating field, the difference in phase between the two circuits being produced by a reactance coil. Within this field is mounted a movable part which is dragged around by the field, and which moves the indicating hand.—*Translated and abstracted from Electro (Brussels), November.*

The Reversal of Charge of Electrical Induction Machines.

In this communication Mr. George W. Walker, of the University of Glasgow, Scotland, describes a method of reversing static induction machines. He observed accidentally that on stopping a small Voss machine and giving it two turns in the wrong direction, and then restarting the machine in the right direction, the poles had been reversed. The experiment was repeated a number of times, and invariably the reversal occurred. The effect was then tried with a vacuum discharge tube connected to the knobs. While the tube was fresh, the reversal occurred, but after a little time the reversal occurred but seldom. It was found, however, that if the discharge was made to pass by connecting one terminal of the tube to earth, and the other terminal to one pole of the machine, while the second pole was kept insulated, the reversal invariably occurred when the procedure mentioned was followed. Next a large Wimshurst machine was tested, with the same results. It was noticed, however, that when the induction rods were so arranged that the machine excited both ways, the reversal did not occur. The author believes that this provides a simple way of getting the discharge to pass in whatever direction is required.—*Abstracted from Nature (London), January 5.*

A Contribution to the Study of Imperfect Contacts.

The first part of an interesting study upon the behavior of coherers, which was carried out by Mr. A. Fisch, is here given. After stating briefly previous work on imperfect contacts, and noting certain of their peculiarities, the method of experimentation is described. Certain early investigators found that coherers and other similar arrangements which do not obey Ohm's law have a resistance characteristic of hyperbolic form. The point of inclination of this curve has been called the critical value. It was found, however, by Guthe and Trowbridge that as the intensity of the current which is passed through an imperfect contact increases, the difference of potential at the terminals of the contact increases at first, but finally takes a constant value, depending only on the material of which the contacts are made. Robinson has shown that the difference of potential across the contacts may attain a value several times that of the critical potential, then falling suddenly to the latter value and remaining constant as the intensity of the current increases. Robinson calls the critical value of the potential that which immediately precedes the fall in voltage. All work previous to that carried out by the author had been done by means of continuous currents. They therefore thought it would be valuable to make a comparative investigation of the behavior of coherers and other similar devices when both alternating and continuous currents were passed through them. The work was done with three coherers, two formed of steel screws, and one of nickel. The results show that a coherer acts as a condenser. If the voltage is not sufficient to affect its resistance, the capacity varies greatly, corresponding to the variable state of the devices. The tests with alternating and continuous current show that for the nickel and one of the screw coherers the fall in potential occurred at a lower voltage for the alternating potential than for the continuous. This condition was reversed for the third coherer, showing that it was not due merely to the maximum voltage of the alternating current being greater than the effective. In fact, the characteristic curves lie too close together for this to be the case. Mr. Fisch concludes that the different results are due to fatigue of the coherer. The first two were tested with continuous currents first, and then with alternating, while with the third coherer the procedure was reversed.—*Translated and abstracted from L'Eclairage Électrique (Paris), December* 31.

Corrosion of Condenser Tubes.

In a paper entitled "Maintenance of Machinery in Merchant Ships," read before the Society of Naval Architects and Marine Engineers by Mr. Robert Hague, the corrosion of condenser tubes was discussed and reference made to the possibility of this being due largely to defects in the electrical supply system which allowed leakage of electric current to occur. As against this probability there is the fact that the trouble has been quite as acute in ships without electric generating plants as in those with such plants, and it does not seem to make any appreciable difference whether the vessel is wired on the single or double-wired system. While reasons have been advanced in support of the theory that the return currents in the single-wired system, or stray currents from defective insulation and connections in the double-wired system, should be accepted as a cause of deterioration in condenser tubes, it is at present difficult to take this as being the only cause. There does not seem to be any reason why electric currents should single out the tubes for attack when there are other metals of almost the same composition exposed to the same conditions, and which yet do not suffer to anything like the same extent. It is recognized that although an electric current of itself may not attack the tubes, the effect of an electric current passing through certain liquids is to split them up and set free corrosive elements from what may otherwise be a comparatively harmless liquid. Considering the conditions of the water in the engine room and stoke-hold bilges, which is a solution of fatty acids, fresh water, salt-water, drainage from hot ashes and all other sources, and in which the various metals are brought in contact. It is reasonable to expect some galvanic action to take place on the fittings so exposed, and such has been found to be the case to a considerable extent in some instances. In some ships corrosion in copper and other pipes from the bilges has been

traced to the use of certain animal or vegetable oils, but up to the present time little definite progress has been made in determining the cause of the trouble in condensers. At this time the theory of electric leakage from the generating current can not of itself be accepted as the only cause of condenser trouble. However, whether electric leakage is the cause or only a contributory cause, the fact remains that condenser troubles have become increasingly frequent since electricity came into more general use on board ships. It is suggested that should it be shown that condenser troubles are due to the electric current generated from any course whatever outside of the condenser, the latter might be insulated so as to protect it from such attacks.—*Abstracted from the Marine Review (Cleveland), January 5.*

The Separation and Analyses of Losses in Direct-Current Dynamos.

An interesting analysis is given here by M. E. J. Brunswick of the losses occurring in continuous-current dynamos. These are first classified according as they vary directly with the frequency or with the square of the frequency. In the former class are found friction and hysteresis losses, and in the latter, Foucault and windage losses. Secondly, the losses may be classified with reference to the induction: those proportional to the induction, such as hysteresis; those proportional to the square of the induction—Foucault losses, and those independent of the induction—friction and windage losses. From these hypotheses the equation for the losses in the generator is $P = a\,\omega + b\,\omega^2$, P being the power absorbed by the losses; ω, the frequency or speed, and a and b constants. From this equation characteristics for different inductions may be plotted, these being in the form of curves, the total power being laid off as ordinates, and the speed of frequency as abscissæ Writing the above equation in the form of $\frac{P}{\omega} = a + b\,\omega$, a system of straight lines may be plotted, having $\frac{P}{\omega}$ for the ordinates, and ω as the abscissæ. These lines, however, do not pass through the origin, but intersect the axis of abscissæ to the left. The equation shows that if P or ω is equal to zero, then a is equal to $-b\,\omega$; that is to say, at this particular point the torque required to furnish the friction and hysteresis losses is independent of the speed, and is just balanced by a second couple proportional to the speed and to the Foucault and windage losses. From the system of lines representing the relation between $\frac{P}{\omega}$ and ω a new characteristic may be drawn, representing the relation between $\frac{P}{\omega}$ and the induction or the shunt current. This curve will intersect the axis of ordinates at some point, and the ordinate at this point represents the torque required to overcome friction. The differences between this value and other ordinates is the torque required to overcome hysteresis. As this characteristic can not always be extended to meet the axis of the ordinates, an approximate point of intersection may be found by drawing a tangent to it at its lower extremity, since it at this point becomes flat. If this solution is not sufficiently accurate, the frictional torque may be found by drawing several such characteristics for different speeds, and then plotting a fresh characteristic between $\frac{P}{\omega}$ and ω. The part cut from the axis of ordinates by this curve gives a new determination for the frictional torque.—*Translated and abstracted from L'Industrie Électrique (Paris), December 25.*

German Electrical Installations—Mine Drainage and Ventilation.

The advantages of electrical transmission of power in mining operations are recognized in Germany to-day, according to M. E. Guarini, who discusses the subject in this article. In opening up new salt and coal mines it is becoming a practice to centralize the whole power in one electric generating station, except perhaps the main hoisting engines. Many large operators are replacing the greater part of their auxiliary steam-driven plants by electrically driven machinery. For power stations the electric generating units are frequently of 500 and 600 horsepower, and sets of 1,000 and 1,200 horsepower have recently been constructed. Electric power stations in mines are generally operated by steam engines, though gases from blast furnaces and waste gases from coke ovens supply the energy in some cases. It has proved exceedingly difficult to find an electrically driven pumping system satisfactory in all respects. At first, efforts were directed to the elimination of all intermediate gearing, but drainage pumps were all constructed for so low a speed that direct coupling was found to be absolutely impracticable, as it was decidedly wrong in principle to bring the speed of the motor down to that of a low-speed pump. Pumps for drainage purposes were constructed to run with increased speed, and at the same time with absolute certainty and greater efficiency. Pumps of 150 to 300 revolutions were designed to fulfill all conditions as to work in mines. The electric motor was also adapted to the changed conditions. An entirely new design of motor became necessary for obtaining good electrical proportions and ventilation, so that when running twenty-four hours a day the rise in temperature would remain within the permissible limit. Besides, the narrow space between the stationary and rotary parts of the three-phase-current motors—which are the only ones which can be considered for mine drainage—rendered an efficient mechanical adjustment necessary. Provision was made for adjusting the stationary part of the motor in a vertical as well as a horizontal position. Finally, transportation through the mine shaft and mine roads necessitated constructions, the largest piece of which could easily be transported to its final position. In the smaller type the rotary part is made in one piece; the stationary, in two pieces. In the larger type the rotary part consists of two, and the stationary of four pieces. A liquid starter for the full output of the motor is sometimes placed in front, connected with a small three-phase motor. The manipulation of the latter, and thereby of the large motor, is effected by a small controller placed at the side of the switchboard. The advantages of a well-designed electrical mine drainage plant are high efficiency, low working expenses and great reliability. While steam plants are subject to various restrictions as regards space and speed, in an electrically driven plant it is possible to use steam engines for the main generating station, which work with the smallest consumption of steam. Besides, for electric pumping plants superheated steam can be used, which is not suitable for underground steam pumps on account of the length of the pipes. A further advantage is that the dynamo machines, electric mains and motors work with a very high efficiency—probably as high as eighty-three per cent. The results with electric drainage plants will be more favorable when superheated steam is used in the primary station. When not working, the electric plant does not require any steam, whereas with steam pumps the entire line must be constantly kept under steam. The yearly cost of maintenance is much smaller for electric driving than for steam-driven or hydraulic plants.—*Abstracted from the Mining Magazine (San Francisco), January.*

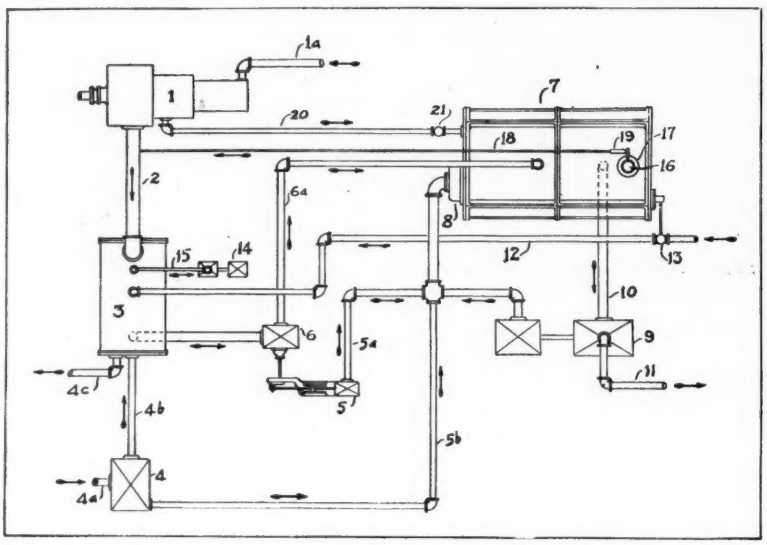
INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Open Feed-Water Heaters in Connection with Steam Turbines.

The Harrison Safety Boiler Works, of Philadelphia, Pa., manufacturers of the well-known Cochrane feed-water heaters, have paid special attention to the adaptation of their Cochrane heaters to plants in which the auxiliary equipment is operated by turbine (the actual and contemplated installations of Cochrane heaters in connection with steam turbines already exceeding 25,000 horse-power), and they have developed some features in these installations which should prove of considerable interest to engineers.

The accompanying illustration shows



FEED-WATER HEATER ARRANGED FOR USE IN CONNECTION WITH A STEAM TURBINE.

an approved method, designed by the Harrison Safety Boiler Works and covered by letters-patent, for heating and regulating the boiler feed-water and is particularly adapted to plants where the steam turbines are operated in connection with surface condensers, although this method is also applicable to plants where surface condensers are used in connection with reciprocating engines.

In this illustration 1 is the main steam turbine taking steam through the pipe 1 *a* from the boiler; 2 is the exhaust-pipe from the turbine to condenser; 3 is the surface condenser receiving the exhaust from 2; 4 is a pump taking cold water through suction-pipe 4 *a* and forcing it through 4 *b* into the condenser to condense the exhaust steam therein; 4 *c* is the discharge for the circulating water from the condenser. An auxiliary engine 5 drives a pump 6 for drawing the condensed steam from the condenser and delivering it to the open heater through the pipe 6 *a*; 5 *a* is the exhaust-pipe from this auxiliary engine joining the exhaust 5 *b* from 4. A Cochrane feed-water heater 7 receives the exhaust from the auxiliaries through the oil separator 8, and a pump 9 takes the feed-water from the heater through the pipe 10 and discharges it into the boilers through the pipe 11. The exhaust from this pump, joining the other auxiliary exhaust, enters the separator 8.

The supplementary cold water feed supply 12 empties into the condenser 3 to make up any difference between the quantity of the condensation of the steam and the amount of water required by the boilers. The supplementary water is controlled by the valve 13 according to the level of the water in the heater 7. This valve is automatically closed or opened by the float and connecting mechanism; 14 is an air-pump exhausting air from the condenser 3 through the pipe 15. In cases where this pump is steam-driven, the exhaust also enters the separator 8.

The heater exhausts to the atmosphere through the pipe 16, which is provided with a back-pressure valve 17.

An air pipe 18 leads into the condenser and is provided with the air valve 19 for passing to the condenser the air which is liberated from the water by heating it in the heater. By this means the air in the heater is disposed of without permitting the escape of steam.

Should there be more exhaust from the auxiliaries than can be condensed in the heater, the pressure increases until it is high enough to open the back-pressure valve 17 and allow the surplus to escape to the atmosphere. It often occurs, however, that the steam from the auxiliaries is insufficient to heat the feed-water to the temperature of the steam itself. In order to cover such cases the pipe 20 is carried to the heater from such a point of expansion in the turbine as will ensure the least loss of effectiveness with the greatest gain potentially for the purpose of making up any possible deficiency in the auxiliary exhaust. In the pipe 20 is placed an automatic throttling valve 21, so adjusted that the pressure of the steam when it enters the heater shall be below the pressure at which the back-pressure valve 17 is set. Thus the supply of supplemental steam from the turbine depends upon the pressure in the heater and is regulated by the needs of the heater itself.

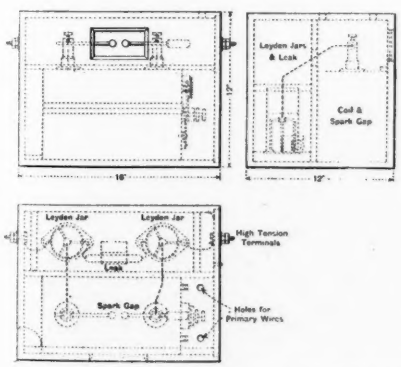
The operation of this novel arrangement has important advantages. In addition to all the condensation of the main exhaust being utilized in the heater, the supplementary cold water is automatically regulated and supplied, and is partially heated in the condenser by the utilization of the latent heat in the main exhaust. All of the exhaust from the auxiliaries is utilized up to the point where they provide more exhaust than is required in the heater, and should the supply fall below the maximum quantity required it is automatically supplemented by steam in the manner already described. The boilers are furnished with water at a uniformly high temperature, there being no sudden fall in the temperature due to variations in the quantity of steam available for heating the water or in the quantity of the supplemental cold water required. The methods by which these desirable results are obtained are simple, positive and entirely automatic.

It will be seen that in a plant in which this method of heating and regulating the boiler feed-supply is used the auxiliaries are of the independent, steam-driven, non-condensing type. The manner in which the exhaust from these auxiliaries is utilized, however, makes them far more economical than the turbine or main engine run condensing, even though the latter may show an efficiency of fifteen per

cent or better. If the auxiliaries were run condensing they could not exceed and probably would not equal this efficiency of fifteen per cent, but when operated in the manner described above, their efficiency is practically 100 per cent, for all of the heat in the steam which is not converted into work or accounted for by losses from radiation, etc. (and these quantities would be identical whether the auxiliaries were run condensing or non-condensing), is utilized in heating the feed-water and turned back into the boilers. This efficiency of 100 per cent compares with the absolute loss of eighty-five per cent which must occur if the auxiliaries are run condensing and the heat in the exhaust dissipated and wasted in the condensing water.

Lodge Electric Igniter for Internal-Combustion Engines.

In the issue of the ELECTRICAL REVIEW for December 31, page 1108, reference is made to a new form of ignition apparatus proposed by Sir Oliver Lodge. The following additional particulars are taken from the *Electrician* (London), December 30. This improved ignition device is manufactured by Messrs. Lodge Brothers & Company, of Birmingham. The chief claim for the new arrangement is that the firing of the explosive charge is rendered quite positive and independent of leaks due to moisture or soot at the spark plug. The general arrangement of the apparatus is shown in the accompanying figure. The constituent parts are: an induction coil, two Leyden jars, a leak,



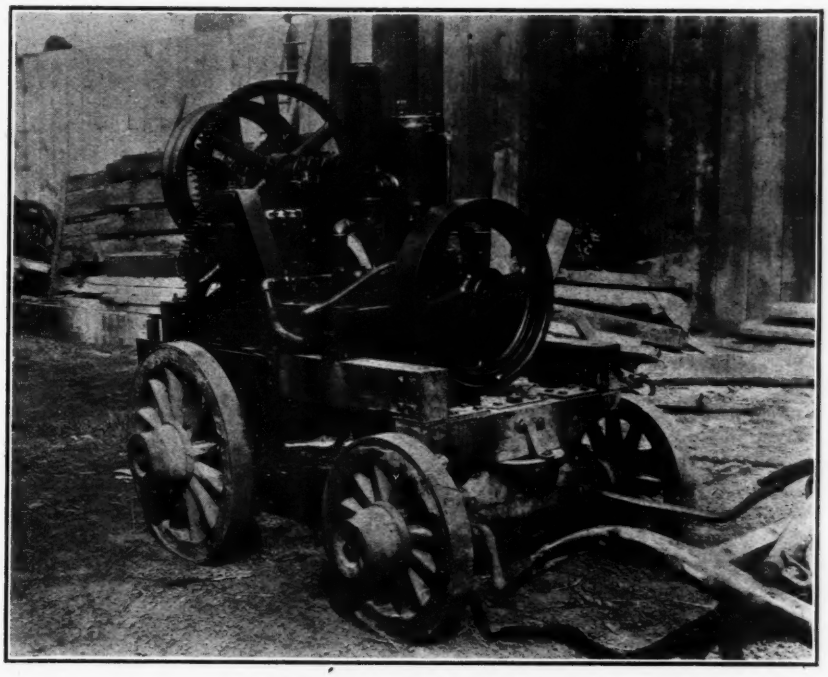
IGNITION DEVICE FOR INTERNAL-COMBUSTION ENGINES.

and a spark-gap. The primary of the induction coil is fed from an eight-volt secondary battery, the current being given a pulsating character by a trembler or any other suitable device. Inspection of the drawing will show that the secondary of the high-tension induction coil is connected to the outer coatings of the two Leyden jars, the inners of which are connected to the adjustable spark-gap. This spark-gap is an auxiliary device for producing well defined disruptions. It is not to be confused with the working spark-gap within the engine cylinder. The last-named spark-gap is connected directly to the high-tension terminals of the induction coil, one of the connections usually being formed by the bed-plate of the engine. In order that the Leyden jars may be charged, it is necessary to have some form of leak between the outside coatings of the jars. This leak must be of sufficient value to allow the jars to charge rapidly, and yet not diminish the volume of the spark in the cylinder by allowing the discharge to pass through it. In the case of the gas engine igniter a special form of liquid resistance is used, which offers a fairly good path to the charging current, and offers a large resistance to the oscillating discharge. The jars have a capacity of the order of 0.0001 microfarad.

The Grinnell Cable-Hauling Machine.

The Knickerbocker Construction Company, New York city, uses the cable-hauling machine shown in the accompanying illustration in connection with the work of installing underground cables for telephone, telegraph, electric light and power companies throughout the country. This machine was patented by Mr. Grinnell, and is known as the Grinnell cable-hauling machine. It weighs about two tons. Power is furnished by a seven-horse-power gasoline engine, which will pull in a 750-foot length of cable weighing eight pounds to the foot.

By means of the machine and five or six men, 5,000 to 6,000 feet of cable can be pulled in in one day. A special feature of the apparatus consists of an iron shoe which fastens to the machine and extends down into the manhole, and which is easily adjusted so as to lead into each duct which is to be used. The shoe is grooved and curved, so that it easily takes the pull rope and the cable without friction, and ensures a steady pull on the cable without injury to the latter. For pulling out cable a similar machine with larger pull wheels is used. The grooves on the wheels prevent buckling of the cable.



GRINNELL CABLE-HAULING MACHINE.

Mr. E. B. Baker, of the Knickerbocker Construction Company, has installed over 150,000 feet of cable for the Northeastern Telephone Company at Lewiston, Auburn and Portland, Me., by the use of this machine.

Wireless Telegraphy in Arctic Exploration.

It has been announced that an effort will be made to keep in communication with Lieutenant R. E. Peary in his proposed search for the North Pole by means of wireless telegraphy. Lieutenant Peary will erect stations at proper points to keep in touch with the coast of Labrador, from which place he hopes to be able to communicate with New York.

Lundell Universal Motors.

The announcement made some time ago that the National Electric Company, of Milwaukee, Wis., had completed arrangements with Mr. Robert Lundell to manufacture and market a new line of Lundell universal motors, was received with a great deal of interest. It was intimated that this line of motors would possess some entirely new features in design and construction, and that their performance characteristics would establish new ideas in motor operation. The company states that these motors are remarkable for their overload capacity, and that their construction is a radical change from other machines on the market at the present time. The component parts have been proportioned and combined to produce a line of motors remarkable for efficiency, low temperature, compactness and rigidity of structure.

The accompanying illustrations give a good idea of the design and assembly of

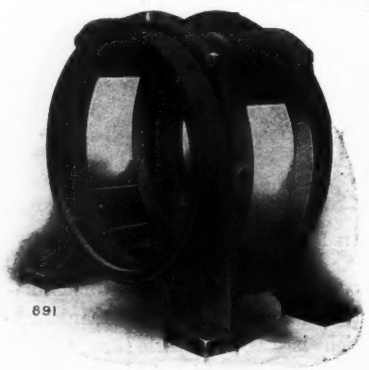


FIG. 1.—THE FRAME.

the motors. Fig. 1 shows the frame, and Fig. 2, the laminated yoke. The cast-iron frames or housings, which contain the laminated yoke rings and support the bearing brackets, consist of a rigid open casing made in two parts—front and rear. The rear portion has four hollow extension-arms of strong cross-section, accurately bored to engage and support the laminations assembled therein. The front frame is identical with the rear, except that the extension-arms are omitted. Bolts pass through these arms, securing the frames together, ensuring a rigid construction. These frames or housings, when bolted together, possess exceptional stiffness. This rigidity, however, is in no way dependent upon the laminations. In fact, it makes no difference to the stability and alignment of the machine whether the yoke laminations are inserted or not. At the same time, the overall dimensions—height and width—of the yoke are not made excessive. The laminated yoke is built up of punched mild steel rings, secured and accurately centered in the rigid frame. The outer and inner diameters of these rings are absolutely concentric. The pole-pieces are separately punched from the same material as the

FIG. 2.—THE LAMINATED YOKE.

yoke rings. These pole-pieces are provided with end-plates, so constructed as to provide ventilating ducts to carry off the heat generated in the field-coils. These end-plates are tapped, and retaining-bolts passed through the frames, accurately seating the pole-pieces and causing them to make perfect contact with the inner diameter of the yoke rings. By removing these bolts, the pole-pieces and field-coils can be readily taken out. Fig. 3 shows the pole-piece in place.

The armature coils are all form-wound on the latest types of frames, and are separately insulated, independent of the slot insulation. The coils are of standard proportions, and provide for ample room at both the back and the front ends. Supporting rings, cast in one piece with the end-plates of the core, serve to hold all ends of the armature coils firmly in place.

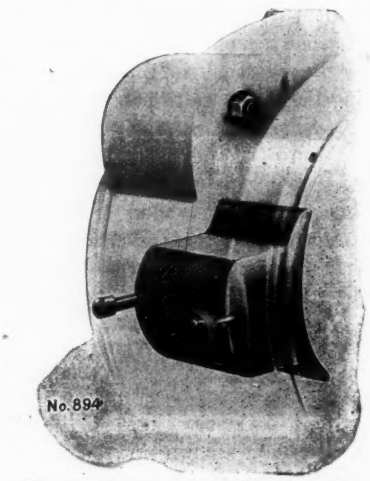


FIG. 3.—SHOWING POLE-PIECE IN PLACE.

In machines up to sixty horse-power it is not necessary to introduce ventilation into the centre of the armature, as in this new line of machines the losses are exceptionally low. These low losses make it possible to enclose these motors at extremely low temperature rise. Fig. 4 shows the armature.

The commutators are built on the lines of standard street railway practice, giving a rigid support to the bars, which are made of hard-drawn copper insulated by selected mica. The commutator shells are ventilated through their centres, this construction bringing about a remarkably cool running of the commutators.

A new principle is involved in the brush device of the Lundell universal machines. This device not only has improved commutation features, but has an operative bearing upon the running of the brush, securing an extremely good performance. Instead of placing the brushes side by side in a line parallel to the commutator bars and the mica, the brushes on the new apparatus are placed one directly in front of the other, in tandem. The total brush surface is the same as when the commutator space is occupied by the side-by-side brushes. Each brush has its independent tension spring. Any irregularity of the commutator surface, however, will not cause both brushes to jump together. The irregularity—if there should be any—strikes only one brush at a time, so that

FIG. 4.—THE ARMATURE.

one may rise while its mate is making contact, the circuit being always closed for that stud. It has been found that this materially reduces the temperature of the commutator, and gives it a much better surface. Where field control is used to obtain broad ranges required by variable-speed work, or where conditions of service call for special commutating conditions, the brush at the leaving edge is made of high-resistance carbon, to take care of sparking conditions, and the other brush of high conductivity to carry the current. In this manner both conditions of service, which are ordinarily opposed to each other, are successfully performed by this dual brush.

Fig. 5 illustrates the simplicity of construction of this motor. Fig. 6 shows the style of motor built in sizes from seven and one-half horse-power up, and Fig. 7 shows a two-arm type built in capacities up to and including five horse-power.

The magnetization losses in the iron,

and resistance losses in the winding, commutator and brushes are so low, due to the economical proportioning of these parts, that the motors run cool, independent of forced ventilation. When running

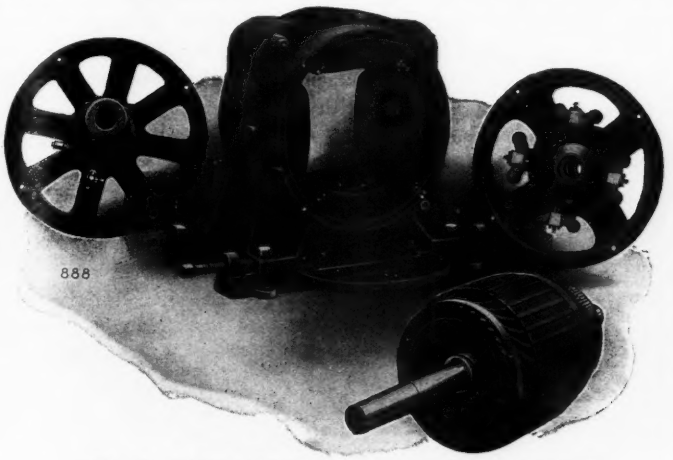


FIG. 5.—ILLUSTRATING SIMPLICITY OF CONSTRUCTION.

under full load continuously, the temperature rise is kept so low that the quality of the insulation is not impaired in the least. Full loads are carried continuously without sparking, and because of the peculiarities of the Lundell tandem brushes, heavy overloads are carried without injury to the commutator or the brushes.

Variable speeds of standard fixed-speed motors, obtained by field control, are permissible within certain limits. For broad ranges of speed, motors of properly selected capacities are used. A range of speed, the lowest and highest points of which are represented by a ratio of three to one, meets most practical cases, and is

FIG. 6.—SHOWING TYPE FROM SEVEN AND ONE-HALF HORSE-POWER UP.

recommended by the company as the ratio of speed to be obtained by field control. These variable-speed motors are remarkably compact, and, the company states, have ample margins for carrying overloads, even when working under difficult conditions of commutation.

The De Cew Falls Power Station, Ontario.

The Hamilton Cataract Power, Light and Traction Company has recently started the two 5,000-kilowatt Westinghouse generators in its De Cew Falls power station in Ontario. Power is supplied from Welland canal feeders, tapped in about fourteen miles above the power station, and at the station the water has a head of 267 feet. The Westinghouse generators are of the two-bearing type, direct-connected to Escher-Wyss waterwheels, and run at a speed of 286 revolutions per minute. They generate three-phase current at a frequency of sixty-five cycles, and a pressure of 2,400 volts. The power is transmitted to the city of Hamilton, Ontario, where it is used for lighting, street railway and manufacturing purposes. A reserve steam-driven station is located at Hamilton, which contains two 1,000-kilowatt Westinghouse generators.

The entire station and high-tension apparatus are of Westinghouse design. The company has two separate three-phase transmission lines to Hamilton, a distance of about thirty-five miles. The high-tension apparatus is designed for a pressure of 40,000 volts, but will be operated for a time at 20,000 volts.

Mr. William V. C. Hawkins is general manager of the Hamilton company, and is also engineer in charge of the installation.

New Electrical Specialties.

Several new electrical specialties have been placed upon the market by Colman J. Mullin, 430 Kent avenue, Brooklyn, N. Y. One of these is a new form of pipe-hanger or ceiling fixture support. This consists of a malleable iron T and a short section of gas-pipe long enough to reach from the floor above to the ceiling below, and supporting a heavy outlet box. This form of hanger obviates the necessity of using scrap pipe for the adjusting of these hangers. The hangers are made in various sizes, and can always be carried in stock.

Another specialty which Mr. Mullin makes is the "Gem" come-along. This apparatus is being used by a number of large construction companies, and it is claimed that it will pull a wire through a conduit without hooks or lugs, and can be slipped over the wire with a minimum of effort and time.

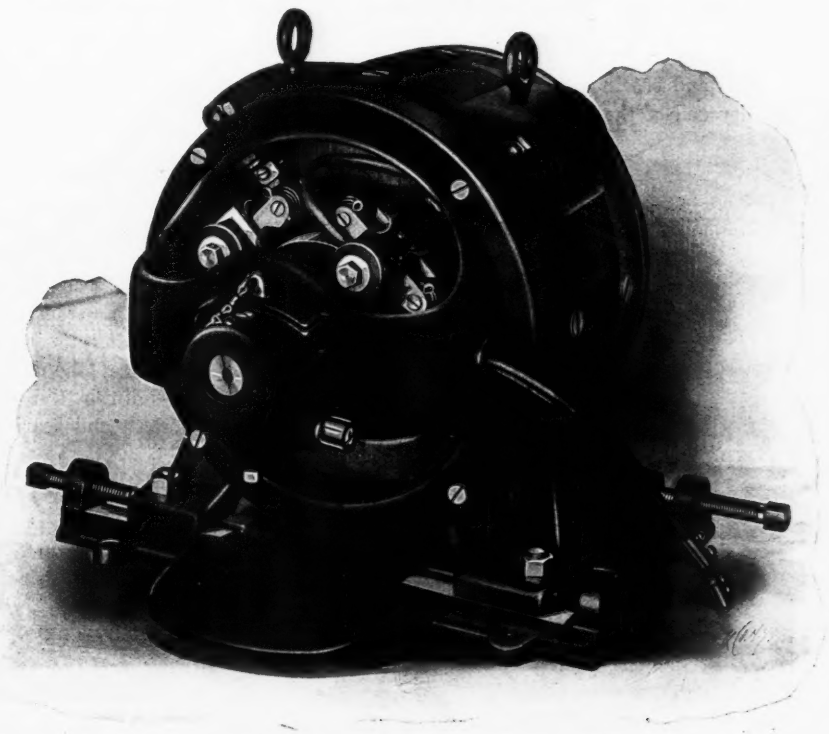


FIG. 7.—SHOWING TWO-ARM TYPE, BUILT IN CAPACITIES UP TO AND INCLUDING FIVE HORSE-POWER.

The "Hold Fast" locknut placed on the market by Mr. Mullin is guaranteed to save time in adjusting and tightening.

In addition to this material, Mr. Mullin manufactures a complete line of pipe-clamps, pipe-hangers, switchboard ironwork, braces, etc.

A New Form of Belt-Driven Alternator.

The General Electric Company, Schenectady, N. Y., has brought out a new form of belt-driven alternator which it designates as form P. This is shown in Fig. 1. The machine is built with two bearings which are mounted one on each end of the shaft. It is of compact design, and occupies less floor space than do machines arranged with separate pillow blocks and bearings. The bearing at the pulley end of the machine is made large, and is placed close to the revolving field spider, in order to bring the pulley close to the machine.

The alternator is of the revolving field type with a stationary distributed armature winding. The revolving field, together with collector rings and exciter armature, is shown in Fig. 2. The machine is designed so that thorough ventilation is maintained in all parts. The base and the stationary armature are shown in Fig. 3.

The poles of the field are built up of laminations, and are fitted into dove-tailed slots in the steel hub by taper keys. The field coils are made from flat copper strip, wound on edge, and are designed for 125 volts excitation. The field poles and edgewise winding of the field coils are shown in Fig. 4. The pulley has a cast-iron centre and pressed paper rim. This type of pulley is considerably lighter, and is able to transmit more power per inch of face than an iron pulley, thus tending to increase the life of the belt and to diminish the strain on shaft and bearings.

The collector rings are of cast iron split in two pieces. Insulated pins, mounted directly on the shaft, support the rings.

The alternators are built with and without direct-connected exciters. The armature of the direct-connected exciter is mounted on the shaft, at the opposite end from the pulley. The magnet frame of the exciter is bolted to the end shield.

The standard designs are adapted to two or three-phase windings without change, except in the armature coils. The exciter and all accessories are the same for both phases. The General Electric Company recommends a standard three-phase winding with a load carried by any two of the three legs, for single-phase work. For this reason no single-phase winding has been standardized.

The machines will carry their full rated capacity continuously on two or three-phase, non-inductive load, the temperature of any part of the machine not exceeding forty degrees centigrade above that of the surrounding air. A twenty-five per cent overload for two hours can be carried with a rise of temperature not exceeding fifty-five degrees centigrade. All machines with three-phase windings will carry seventy-five per cent of their rated polyphase capacity in single-phase current with the same temperature rise as is given for two and three-phase windings. They will carry the full rated capacity in single-phase current for a period of three hours without injurious heating. Three-phase machines are designed for potentials of 240, 480, 600, 1,150 and 2,300 volts, and two-phase machines are designed for potentials of 240, 480, 1,150 and 2,300 volts.

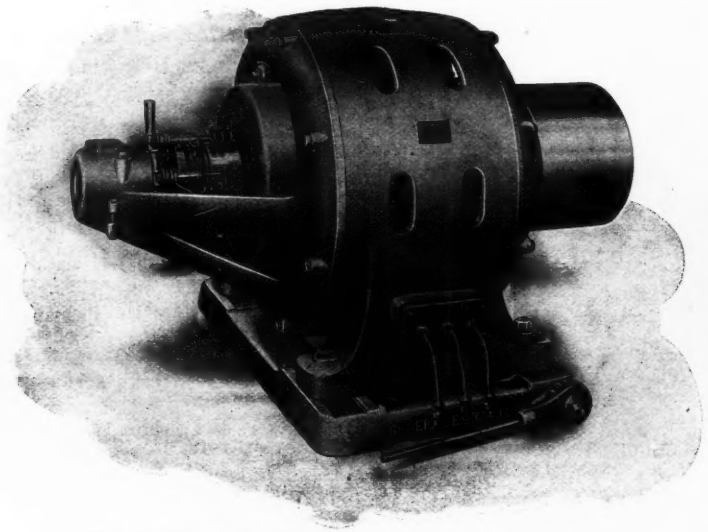


FIG. 1.—REVOLVING FIELD, BELT-DRIVEN ALTERNATOR.

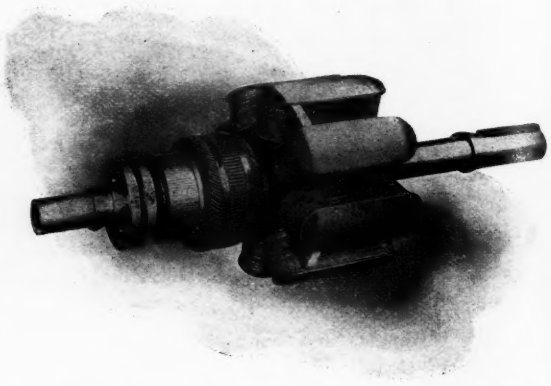


FIG. 2.—REVOLVING FIELD OF BELT-DRIVEN ALTERNATOR.

FIG. 3.—BASE AND ARMATURE OF BELT-DRIVEN ALTERNATOR.

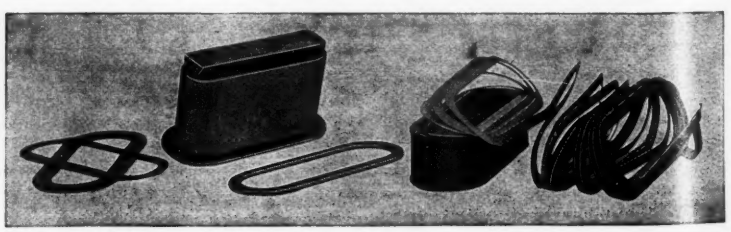
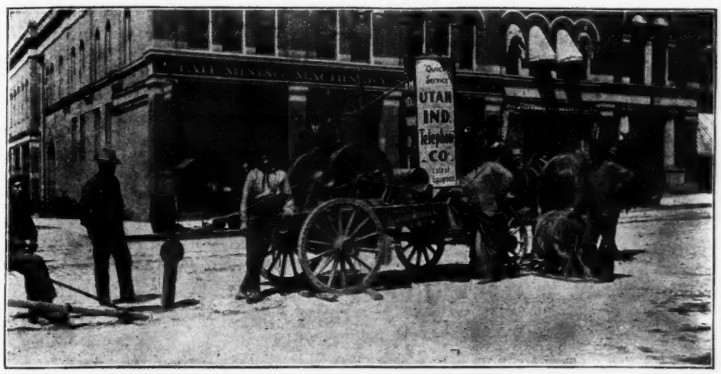


FIG. 4.—FIELD POLES AND COILS OF BELT-DRIVEN ALTERNATOR.

Cable-Laying Engine.

Fairbanks-Morse & Company, Chicago, Ill., build a power, cable-laying engine for telephone work. Telephone companies as well as other corporations are realizing that field work can be greatly facilitated by the use of power. There was a time when the laying of cables was done by hand and on account of the size of the cable and other conditions, the hand work was sufficiently rapid. Later on either more extensive hand power or in some cases animal power was required, but even this was not sufficient to take care of the present demands and the increasing size of cable. Therefore, the gasoline engine was called into service; a very ingenious combination of a vertical engine and winding drum together with a winch head has been arranged. The winch and engine are built complete on one iron base, making them self-contained and rigid, but at the same time light. This apparatus is then mounted onto an ordinary platform wagon, which can be hauled either by hand or by horse. The wagon also answers to carry tools and other material and apparatus which would be used in connection with the work. A small tank holding the fuel for the engine completes the outfit. The engine being electrically ignited is free from any danger, and is not affected in winter weather.



FAIRBANKS-MORSE CABLE-LAYING ENGINE.

An apparatus on the style of the above described was recently installed by the Independent Telephone Company at Salt Lake City, and while laying some of its cable, it established a new world's record on telephone cable work. The crew, under the direction of Chief Engineer Frank B. Hall, succeeded in laying 14,719 feet of 200-pair cable in seven hours and forty minutes, and the best previous record which was made in St. Louis in 1898 with nine men and a foreman was 7,556 feet of 120-pair cable; eight and one-half hours being required to accomplish the laying of the small cables. The chief engineer in charge of the new apparatus expressed himself as being entirely satisfied with the new apparatus, and feels that it is without doubt the best method of laying cable yet discovered. The six-horse-power Fairbanks-Morse combined vertical engine and winding gear is arranged with a sixteen-inch diameter drum and a five-inch winch or nigger head. The wagon upon which the apparatus is mounted is constructed with a three and one-half-inch running gear, having a reasonable heavy bed made of the best six-inch by eight-inch Oregon pine. The engine is arranged with a speed-regulating device so designed that it can be operated from either side of the running gear, and by the use of the speed change the engine can be controlled to any speed you desire.

In laying the large cable a one-half-inch wire rope was used, one end being attached to the large cable, passed through the subway and connected to the drum of the engine, and a pull of any distance can be made, as the engine has ample power to take care of long pulls. As much work has been accomplished by the use of the above described apparatus in five minutes as would have been accomplished formerly by four men in two hours. It would, therefore, appear from the description and the records that an apparatus of this kind would find great favor among many of the large telephone companies throughout the country.

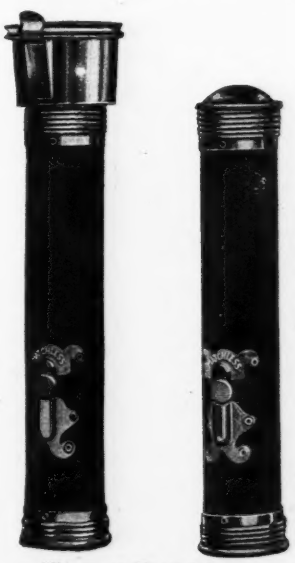
Electric Flashlights.

The accompanying illustrations show the "Matchless" flashlights placed upon the market by Stanley & Patterson, 40 Cortlandt street, New York city. These electric flashlights have become very popular for service in many directions. Where there is any liability of explosion, due to elements with which the air may be permeated, the pocket electric light is deemed a great safeguard over other forms of lighting apparatus in which a naked flame is used.

The flashlight apparatus here illustrated is provided with a patented contact device. This makes it possible to manipulate the flashlight with one hand, and the illumination may be either momentary or of longer duration.

A knurled button is attached to a spring, and slides forward on the surface of this spring. For momentary lighting it is only necessary to press down upon the button. When it is desired to continue the illumination it is only necessary to move the knurled button slightly forward with the thumb. This will carry forward a metal tongue under the lock, and until the button is moved back again the light will remain burning.

The flashlight cylinders are made of vulcanized fibre which is given an extra finish and polished in oil. This makes the case impervious to moisture. The appearance of the tube after this process is completed is similar to polished ebony. All of the metal parts are riveted to the cylinders with hollow rivets, securely clamping the fittings to the fibre.



ELECTRIC FLASHLIGHTS.

The flashlights are made in eight sizes, giving various numbers of flashes from 500 to 5,000, and containing in the various forms different types of reflectors and incandescent bulbs.

Two English inventors have made an adaptation of wireless telegraphy for entertaining purposes. Music boxes placed in different parts of the room are caused to play on the placing of a coin in a receptacle at a common centre.

Valuable Convention Souvenirs.

At the convention of the Northwestern Electrical Association, held in Milwaukee, Wis., last week, a number of the companies distributed valuable souvenirs. The accompanying illustrations show the watch fobs distributed by the Allis-Chalmers Company and by the National Electric Company. The pendant on the fob given

SOUVENIR OF THE NORTHWESTERN ELECTRICAL ASSOCIATION CONVENTION.

to the delegates by the Allis-Chalmers Company was ornamented on one side with the trade-mark of the Bullock Electric Manufacturing Company, and on the other side with the trade-mark of the Allis-Chalmers Company.

The pendant on the fob distributed by the National Electric Company was a reproduction of the trade-mark of the company. This showed the field-poles of a direct-current machine on the upper half portion, and the armature ring of a revolving-field alternator on the lower half portion. The two halves are joined together by a scroll bearing the word "National." On the reverse side of the medal was inscribed, "Northwestern Electrical Association, Milwaukee, Wis., January 18, 19 and 20."

Electric Power in New Zealand.

Mr. L. M. Hancock, electrical engineer, spent some time during the fall of last year in New Zealand, investigating the possibilities of water-power development there for the New Zealand government. A brief summary of his conclusions is given in a recent report from United

SOUVENIR OF THE NORTHWESTERN ELECTRICAL ASSOCIATION CONVENTION.

States Consul-General F. Dillingham, at Auckland, New Zealand.

Mr. Hancock says that both islands have great water-power resources which will repay investment, and that the development which has already taken place is excellent. He believes that the business of the colony has reached such a stage that larger investments in plants for generating and transmitting power will be profitable, and that development in this direction will do more to advance the material interests of the country than any other agency.

The Wairua river, which is about fourteen miles from Whangarei, and eighty-four miles from Auckland, is the nearest power to the great industrial centre of Auckland. At this point a dam from thirty to fifty feet high can be built, which will give the benefits of storage and increase the possible power production. The main disadvantage of this water power is its distance away. At Aratiatia rapids, on the Waikato river, there is a valuable power location, and there is another at Huka Falls.

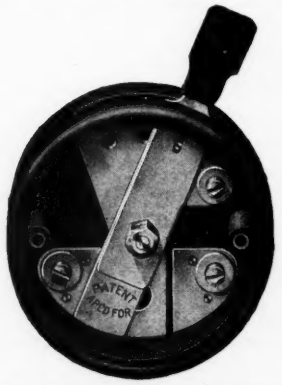
While there is no question that the water power of the islands is ample to handle the entire railway system, Mr. Hancock believes that the question of doing this is one of business policy, and should be approached with caution. At the present time New Zealand is distinctly an agricultural and dairying colony. It is thought that the development of these water powers may tend to make it a manufacturing centre.

New Battery Switch.

The Atwater Kent Manufacturing Works, 112 North Sixth street, Philadelphia, Pa., is placing on the market a new battery switch which is intended to be convenient and durable, and which is designed on the style of larger electrical apparatus. This switch is shown in the accompanying illustration.

The handle-end of the lever is provided with notches to keep the lever in the position desired. The handle is substantially made, and can be easily manipulated when the hand is covered with a heavy glove. Locking devices have been omitted on this switch, as these are easily rendered ineffective, and the owner is often annoyed by mislaying the removable part.

Another convenient feature of the switch is that all connections are made after the switch has been mounted on the dash, and the hole is then covered



NEW FORM OF BATTERY SWITCH.

by the name-plate. This avoids bending the wires, making a poor connection. Examination of the connections may be made by simply removing the name-plate. The switch is well designed and substantially made. All the brass parts are made of heavy metal, and the only two holes that are tapped in the insulating part are bushed with brass.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

TWENTY MILLIONS NEEDED FOR IMPROVEMENTS ON BROOKLYN RAPID TRANSIT—The New York State Board of Railroad Commissioners has recommended that the Brooklyn Rapid Transit Company spend $20,000,000 in order to improve its service. The expenditure should be divided over a period of three years, $8,500,000 being spent the first year, $5,000,000 the second year, and the balance the third year. It is recommended that 100 new cars be placed on the surface lines, and 200 on the elevated lines, and that $2,300,000 be spent in additional power supply.

ELECTRIFICATION OF LAKE ERIE & WESTERN RAILROAD—It has been announced that the Lake Erie & Western Railroad Company will put electric cars on its road next spring. Negotiations between officials of the road have been going on for some time with several of the motor car companies in regard to supplying cars for the use of the road. The Lake Erie has had the matter under advisement for some time and has been watching the result of the electrical experiments on the New York Central lines. It is expected that an hour schedule will be arranged for, and it is reported that the cars will be geared to make sixty miles an hour.

INCORPORATION OF GREAT NORTHERN POWER COMPANY IN MINNESOTA—Amended articles of incorporation of the Great Northern Power Company, which purposes to furnish electric power and light to Duluth, Superior and the towns of the iron ranges in Minnesota, were filed in the office of the clerk of the court in Duluth, increasing the amount of the capital stock from $100,000 to $2,000,000. Charles D. Barney & Company, bankers, of New York and Philadelphia, Tucker & Company, bankers, of Boston, and the Knickerbocker Trust Company have provided $4,000,000 for the completion of the work, and the officials assert that power will be delivered at the head of the lakes within eighteen months.

NEWS NOTES FROM MEXICO—The work of constructing a telephone line between San Luis Potosi and San Felipe, Mexico, has been completed. The Mexican government has declared forfeited the concession which was held by J. Woesner, of Saltillo, for the construction and operation of a system of long-distance telephone lines in northern Mexico. Part of this system has been constructed and is in operation. The Mexican Light and Power Company has projected a transmission line to transmit electric power to the districts of Temascaltepec, Zacualpam, Sultepec, Taxco and Malinaltenango. The company contemplates furnishing electrical energy to these districts, and the final surveys are now being made. A transmission line from Mexico City to El Oro is now under way, and it is expected that it will be completed by June.

REORGANIZATION OF SODUS BAY ROAD—The Sodus Bay (N. Y.) road has been reorganized by the filing of a certificate of reorganization of the company known as the Corning, Lake Keuka & Lake Ontario Railroad. The certificate of reorganization was filed by R. H. Curtis, of Bradford, N. Y., who has joined with Pittsburg capitalists in the company, which is capitalized at $1,500,000. The new company will construct the division of the road between Savona and Penn Yan, and work will be commenced immediately. The directors of the road are Benjamin Hedges, Frank Hedges, Robert Curtis, John C. Zimmerman, Frank Plaisted, William Barcley, Fred Crosby, Dwight Little, Frank Sears, Solomon R. Wilson, Guy M. Crane, David Hoover and Henry Knickerbocker. Connections will be made with the Erie at Savona, and the road will touch Bradford, Sonora, Tyrone, Lake Lamoka, Wayne, Keuka, Barrington, Warsaw and Penn Yan.

MICHIGAN ELECTRIC LINES MERGER—A merger of practically all of the electric railroads and light and power companies in the southwestern part of Michigan is announced in connection with the filing of a $1,200,000 mortgage given by the Commonwealth Company to N. W. Harris & Company, of Chicago. The mortgage is to secure bonds of the new merger company, Harris & Company having undertaken to finance the Commonwealth Company. This company purposes to supply power for all the interurban electric roads now in that section, and also to supply light and power to all cities and towns along its lines. The Commonwealth Company absorbs the Battle Creek & Jackson Electric Railway Company, the Kalamazoo Valley Electric Company, the Plainwell Electric Company, Limited, the Otsego Power Company, the Kalamazoo electric lighting plant, the dam sight at Allegan, and all the Battle Creek, Jackson, Kalamazoo, Otsego, Allegan and Plainwell lighting franchises.

ENGINEERING SOCIETIES.

WASHINGTON UNIVERSITY BRANCH OF A. I. E. E.—The Washington University branch of the American Institute of Electrical Engineers held a meeting on January 20, 1905, at St. Louis, Mo. The topic of discussion was "Engineering Features of the New York Subway." The regular date of meeting is the first Friday of each month. Present irregularities in the meetings are due to the removal of the university to its new site.

PENNSYLVANIA STATE COLLEGE BRANCH OF A. I. E. E.—The Pennsylvania State College branch of the American Institute of Electrical Engineers met Wednesday evening, January 18. A paper on "Some Hints on Conduit Work" was read by R. B. Arnold; L. F. Adams read an article on "Some New Westinghouse Crane Motors," and T. H. Arnold read a report of research work on the "Separation of Electrolytic White Lead." A question box was then discussed, and the meeting adjourned. The next meeting will take place on February 1, 1905.

THE WESTERN SOCIETY OF ENGINEERS—The Western Society of Engineers, Monadnock Block, Chicago, Ill., has elected the following officers for 1905: president, Edward C. Carter; first vice-president, G. A. Liljencrantz; second vice-president, Charles F. Loweth; third vice-president, L. P. Breckenridge; treasurer, Andrews Allen; secretary, J. H. Warder. Trustees: B. E. Grant (one year), T. W. Snow (two years), George M. Wisner (three years). Past-presidents in the board of directors: W. H. Finley, Ralph Modjeski and H. W. Parkhurst.

NEW YORK ELECTRICAL SOCIETY—At the 247th meeting of the New York Electrical Society, held on January 18, Professor William S. Franklin, of Lehigh University, lectured on "Electric Waves and the Reaction of Transmission Lines." Professor Franklin illustrated his lecture by a number of lantern slides, and brought to the notice of the large audience several new ideas with regard to the progress of theory in this field. The following members were elected: William C. Ward, C. G. Owens, G. H. Hodges, Joseph M. Roman, H. G. Stott, C. D. Gray, C. H. Nichols, Robert P. Parrott, M. J. Maguire, Charles C. Mathews, Walter Lawrance, Frank W. Uttal, R. B. McVey, W. G. Ritter, F. G. McMahon, Robert Thistlewhite and Paul T. Kenny.

THE ELEVENTH ANNUAL MEETING OF THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS—The eleventh annual meeting of the American Society of Heating and Ventilating Engineers was held at the Hotel Astor, New York city, from January 17 to 19, 1905. At the evening session on January 17 the report of the tellers of election was received, and a paper on "Appliances and Results in Exhaust Steam Circulation," by James A. Donnelly, was read. The second session was held on Wednesday afternoon, January 18, when the following papers were read: "Investigation of Accuracy of a Direct-Reading Hygrometer," by R. C. Carpenter; "Gas as a Fuel for Hot Air Heating," by R. S. Thompson, and "Steam Heating in Connection with Condensing Engines," by Reginald Pelham Bolton. At the morning session on Thursday, January 19, papers were presented on "Experience with Radiators in the Top Story of a Building," by A. B. Reck; "Circulation of Hot Water," by John S. Brennan, and at the afternoon session a paper on "European Methods of Heating Fifty Years Back," by R. C. Carpenter, was read. The following officers were elected for the ensuing year: president, Professor William Kent; first vice-president, Reginald Pelham Bolton; second vice-president, C. B. J. Snyder; treasurer, U. G. Scollay; governors, B. H Carpenter, B. F. Stangland, James Mackay, A. B. Franklin and J. C. Trachsel. On the evening of Wednesday, January 18, the annual dinner of the society was held at the Hotel Astor. New York State Senator Wray was present and made an address.

TELEPHONE AND TELEGRAPH.

RIVERSIDE, CAL.—The Home Telephone Company is now connected with Beaumont.

FARMINGTON, WASH.—A new telephone line is being extended from Oakesdale to Farmington.

SPRINGFIELD, ILL.—The work of stringing a line from Bloomington to Springfield has been completed.

RUSHVILLE, IND.—The Spiceland Cooperative Telephone Company has applied for a franchise in Rushville.

FARGO, N. D.—The Northwestern Telephone Company is expected to extend its line from Jamestown to Bismarck later in the year.

OWINGSVILLE, KY.—A company has been organized to build a telephone line from Moore's Ferry to Salt Lick, a distance of five miles.

SCRANTON, PA.—The Pennsylvania Telephone Company has installed a new switchboard in its exchange in Scranton at a cost of $200,000.

PHILADELPHIA, PA.—The Diamond State Telephone Company will shortly build lines from Easton to Welsh Point and Cowantown.

CUMBERLAND, MD.—The Western Maryland Telephone Company has completed connections through to Uniontown and Connellsville, Pa.

FULLERTON, CAL.—On account of rapidly increasing business, the Sunset Telephone Company has decided to again rebuild its system in Fullerton.

HUNTINGTON, W. VA.—The Southern Bell Telephone and Telegraph Company has purchased the Catlettsburg & Ashland Telephone Company's lines.

ST. CHARLES, MO.—The new switchboard at the Bell Telephone Company's exchange has been put into operation. It has connections for 2,800 telephones.

EDWARDSVILLE, ILL.—The Central Union Telephone Company is installing a new telephone system in Edwardsville, representing an expenditure of about $10,000.

CHANUTE, KAN.—The Wareham & Wood Telephone Company has made a proposition to the Chanute city council to sell the telephone system to the city for $60,000, payable $10,000 a year in quarterly instalments.

MORGANTOWN, PA.—The Conestoga Telephone Company has decided to build a new line to Elverson and also a new one to Joanna. The line has been completed to Plowville. Work will begin in the near future on a line to Reading.

RICH HILL, MO.—The Rich Hill city council has received a proposition from S. J. McComb, of Humansville, Mo., to put in a local telephone system, give the city two per cent of the gross receipts and free municipal telephones, providing a twenty-year franchise is granted.

UTICA, N. Y.—During the past two months the Bell Telephone Company has spent about $50,000 in subway extensions in Utica. These subways will average six ducts each, with a carrying capacity of six cables, containing 3,600 wires. The company expects to make further subway extensions the coming spring.

MARION, S. D.—The telephone exchange in Marion is now completed and in good working order. It was established by the Marion Telephone Company, which has been incorporated with a capital of $10,000. The officers are: president, Jacob Hieb; vice-president, Fred Hausauer; secretary-treasurer, A. E. Hofer.

OXFORD, N. Y.—The new telephone line of the Oxford Valley Company has been constructed from Oxford to Brisbin, where it connects with the Chenango Valley line. It is reported that a large share of the $2,000,000 to be expended by the Central New York Telephone and Telegraph Company will be used to improve the service in this section.

HUNTSVILLE, ALA.—The Seyforth Building has been leased for a term of ten years by the Southern Bell Telephone and Telegraph Company, which will establish its local exchange there. The company will send a large force of men to Huntsville to install a common battery system and make other extensive improvements in the telephone service.

LEBANON, OHIO—The stockholders of the Valley Telephone Company have elected the following members to serve on the board of directors: O. M. Bake, George G. King, H. S. Conover, Gibson Lowe and James Stoops. This company represents an outlay of $107,000 and has real estate valued at $3,000. During 1904 the company cleared $10,000.

ALLENTOWN, PA.—The Consolidated Telephone Company, of Pennsylvania, has completed its trunk lines from Reading to Lebanon, and will be in a position in a few days to give direct communication between Reading and Lancaster, Lebanon and Dauphin counties. In a short time the line between Hamburg and Pottsville will be completed.

MIDDLETOWN, N. Y.—Harvey Albee, receiver for the Beaverkill Telephone Company, recently sold the line at Roscoe to creditors for $1,250. These are S. D. Maynard, E. B. Palen, J. W. Johnston, Harley Albee, Jay Davidson, M. N. Dodge, W. E. Sprague, J. Campbell and O. P. Sprague. The probability is that a new company will be formed and the line reconstructed.

GOSHEN, IND.—J. K. Johnston, formerly of Louisville, Ky., has, with business associates, leased the plants of the Home Telephone Company, comprising the big exchanges at Elkhart and Goshen and smaller systems at New Paris, Wakarusa and Middlebury. The Home Telephone Company is headed by Braley & Barber, of Cleveland, who have large telephone interests at Kansas City and other western points.

TACOMA, WASH.—Seven telephone lines, covering the largest part of the Palouse wheat district in Eastern Washington, are to be merged by their farmer owners into one company, to be governed by a board of seven farmers, one to be elected by each line. A central exchange will be established in each town through which the lines run. Stockholders will be given free connections, and all lines will be charged a small fee in order to maintain central exchanges. The present lines are the outgrowth of private lines started three years ago.

UTICA, N. Y.—The Independent Telephone Securities Company has purchased a controlling interest in the Black River Telephone Company. The Independent Telephone Securities Company has been incorporated with the idea of merging the independent companies in the northern part of New York state. The Black River Telephone Company's lines extend from Utica north along the lines of the Rome, Watertown & Ogdensburg and Black River railroads. The company has exchanges in twenty-two villages and operates over 1,000 telephones. It has more than 500 miles of toll lines, which reach nearly every village in the northern part of the state.

YOUNGSTOWN, OHIO—The Youngstown Telephone Company has completed several important extensions to its local telephone service. New lines have been put up to Sharon and Greenville. A private branch exchange has been installed in the office of the Youngstown & Sharon Railway Company, and a deal has been closed for a private line to the Bessemer limestone quarries near Lowellville. During the past year the Youngstown Telephone Company put in 800 new telephones. Quite a number of farm lines have been erected and several toll lines have been added to the system. The latter include one to Canfield. The new Sharon and Greenville lines give direct connection from Youngstown to many towns in Western Pennsylvania and New York state.

UTICA, N. Y.—The independent telephone exchanges at Cooperstown and Richfield Springs, together with the rural lines of the Otsego Home Telephone Company in and about Cooperstown, have passed into the hands of the Independent Securities Company, of Buffalo, a branch of the syndicate now controlling the local companies in Rochester, Syracuse and Utica. It is reliably stated also that other independent companies are considering a proposition for a sale to the Utica company. The Cooperstown exchange has about 250 telephones, and the Richfield Springs exchange about the same number. In the towns about Cooperstown there are some 200 telephones of the Otsego Home company, and these will be connected with the exchange at the county seat and given service from that point. The companies at Cooperstown and Richfield Springs were organized by Fred C. Ward, formerly of Delhi, about three years ago, and he soon connected the two towns. The Otsego Home company was capitalized at $40,000.

CLINTON, N. J.—The Lebanon Telephone Company has extended its line to Flemington.

CALEDONIA, N. Y.—The Bell Telephone Company will build a line south from Chili Station.

SANTA MONICA, CAL.—The Home telephone franchise has been sold to Louis Blankenhorn.

AURORA, ILL.—The Chicago Telephone Company is making extensive improvements to its system in the vicinity of Aurora.

WEST CHESTER, PA.—The Western Union Telegraph Company will erect a new line between Chester and Darby, and upon its completion will start work on a line from Wilmington to Cape Charles.

BESSEMER, ALA.—The Southern Bell Telephone Company will at once commence the construction of a line from Bessemer to Virginia Mines, a number of subscribers having been secured at that point.

ALTON, ILL.—A franchise has been granted by the Madison County board of supervisors to the Fosterburg Farmers' Mutual Telephone Company to construct and operate a telephone line from Fosterburg to Alton.

SALEM, MO.—The Salem city council has passed an ordinance granting the Bell Telephone Company the right to erect poles and wires on the city streets. It is expected that the line will be built at once from Steelville.

DRYDEN, N. Y.—A farmers' telephone company is constructing a line from Chenango Forks to Whitney's Point, Killawog, Marathon, Messengerville, and Virgil, where it will connect with the line of the Dryden Telephone Company.

UPPER LISLE, N. Y.—At the annual meeting of the Upper Lisle Telephone Company the following officers were elected: president, Frank Brannan; secretary, Arthur Rooks; treasurer, Martin Sherwood; directors, John Stalker and George A. Landers.

HAMLET, IND.—Surveyors are running a line for the erection of a new telephone line which will be built to connect Plymouth with a number of Marshall County and Starke County towns, with the western terminal at Knox. The line is to be put in operation the coming spring.

RAWSON, OHIO—The following officers have been elected by the Farmers' Mutual Telephone Company, at Berton Ridge: president, J. H. Kirtland; treasurer, Daniel Jackson; secretary, P. A. Kemerer; trustee, G. C. Clymer. The line will be built at once, and will have connection with Findlay.

CLIFTON, TENN.—The Consolidated Telephone Company, which recently acquired all the various telephone systems in the neighborhood of Clifton, is arranging to install an exchange at Waynesboro. It is probable that the line will be extended to the Nashville, Chattanooga & St. Louis Railway at Allen's Creek.

OSWEGO, N. Y.—At the annual meeting of the stockholders of the Ontario Telephone Company. the following officers were elected: president, F. A. Emerick; vice-president, Niel Gray, Jr.; secretary, Elisha B. Powell; treasurer, R. Arthur Downey. The company now operates about 1,175 telephones, 925 of this number being in Oswego.

BERGEN, N. Y.—At the annual meeting of the Bergen Telephone Company officers were elected as follows: president, G. M. Gillette; vice-president, J. S. Gleason; treasurer, C. E. Housel; secretary, H. C. Miller; directors, the officers and R. M. Andrews, W. F. Smeltzer, W. E. Gillette, W. M. Sage, George E. Parish, George A. Johnson, George E. Best, George Sands.

CAMDEN, MICH.—At the annual meeting of the Camden Rural Telephone Company, the following officers were elected for the ensuing year: president, Henry Haynes; vice-president, George A. J. Palmer; secretary, S. E. Haughey; treasurer, B. R. Alward; directors, S. S. Townsend, James Crow, Charles Small, Alfred Small and F. W. Rowe. The company installed 300 telephones during 1904.

ST. LOUIS, MO.—The Suburban Telephone Company, of Clayton, has completed connection with the Kinloch company, of St. Louis, bringing the residents of Clayton and other towns in St. Louis County into direct telephone connection over the Kinloch wires with St. Louis. There are about 100 telephones in use in Clayton and thirty-five in Ferguson. The Suburban company has in use automatic telephones.

BUFFALO, N. Y.—It is reported from Columbus, Ohio, that the Hocking Valley Railroad has contracted with the Bell Telephone Company to place a long-distance wire along the line with a view of installing a telephone system similar to the one recently completed on the Lake Shore. There are to be stations at Toledo, Walbridge, Upper Sandusky, Marion, Delaware, Lancaster, Logan, Athens and Nelsonville.

HORNBY, N. Y.—The Hornby Telephone Association has been reorganized under the laws of the state of New York. The directors are H. T. Jimmerson, Walter Davis, E. J. Easterbrook, C. C. Roloson, A. C. Gifford, C. R. Adams, Edwin Dodge. Officers were elected as follows: H. T. Jimmerson, president; C. R. Adams, vice-president; C. C. Roloson, treasurer; A. C. Gifford, secretary. Fifteen miles of new line were added to the system during the past year.

PITTSBURG, PA.—At the annual meeting of the Maryland, Pennsylvania & West Virginia Telephone Company all the old directors were reelected except E. H. Reid, of Scottdale, and E. T. Norton, of Connellsville, who declined reelection, and whose places were filled by S. M. Graham, of Uniontown, and A. C. Sherrard, of Vanderbilt. The company will extend its lines over Fayette County, and will provide 400 more telephones in both Uniontown and Connellsville.

DECATUR, ALA.—The Morgan County Telephone Company has completed its long-distance line to Hillsboro, thirteen miles from Decatur. It has only to build to Tuscumbia, about forty-five miles, where it will connect with the independent company from Memphis. When this link is completed Decatur will have long-distance connection with all of the northern states, both through the Morgan company and the Bell system. The Morgan County people expect to build from Decatur to Birmingham at an early date.

TRENTON, N. J.—The stockholders of the Inter-State Telephone Company have elected the following board of directors: W. S. Hancock, Barker Gummere, Governor-elect E. C. Stokes, Hugh H. Hamill, H. C. Loudenslager, of Camden; C. W. Kline, of Hazleton, Pa.; G. R. Bedford, of Wilkesbarre, Pa.; John Markle, A. C. Markle, of New York; G. N. Reichart, of Wilkesbarre, Pa.; R. P. Wilson, of Trenton; Louis Kuehnle, of Atlantic City, N. J.; J. W. Crelin, of Hazleton, Pa.; Thomas Daugherty, of Allentown, Pa.; F. A. Demarest, Trenton.

BALTIMORE, MD.—The Cecil Farmers' Telephone Company has placed in operation its line from Rising Sun to Port Deposit, where it has connection with the Maryland company. A spur has also been extended to Colora. The company will have the connections at the Pennsylvania line with the United Telephone Company of Chester County. The Cecil Farmers' Telephone Company is an independent concern, organized by the Cecil Farmers' Club and granted a charter by the last legislature of Maryland. The members of the Farmers' Club constitute the board of directors, with Elwood Balderston, president, and Cecil E. Ewing, secretary. The work of installing telephones is being pushed.

BALTIMORE, MD.—The Chesapeake & Potomac Telephone Company has closed a contract with the Southern Maryland Telephone Company whereby the lines of the companies will be connected at Brandywine. By this move all southern Maryland towns through the exchange at Upper Marlboro will have long-distance connection with Baltimore and the North. The Southern Maryland company has agreed to use the instruments and apparatus of the Chesapeake company, and thus become virtually a part of that system. The Southern Maryland company is already operating exchanges at Leonardtown, Mechanicsville and Charlotte Hall, and in the near future expects to open exchanges at La Plata, Brandywine and other points. Early in the spring, it is said, it is the intention of the company to extend its lines south to Point Lookout, and westward to La Plata and all Potomac river points, by which combination southern Maryland is assured of connection with Washington. It is also understood that negotiations are under way between the Southern Maryland company and the Chesapeake company for the leasing of the latter's lines in Calvert County.

ELECTRIC LIGHTING.

UVALDE, TEX.—A franchise has been granted for the installation of an electric light plant.

COLUMBIA, KY.—The franchise for the operation of an electric light plant in Columbia has been sold to Myers Brothers.

GOLDFIELD, COL.—The new electric light plant, which has a capacity of over 1,200 lights, has been placed in operation.

JONESBORO, ARK.—J. F. Gautney contemplates the erection of an electric plant to transmit power a distance of 100 miles.

FORREST CITY, ARK.—Eugene Williams, cashier of the Bank of Forrest City, has purchased the electric light plant for $10,000.

STOCKETT, MONT.—The Cottonwood Coal Company is arranging for a larger and more adequate electric light plant. A 2,000-light dynamo has been ordered.

TROY, N. Y.—The Ballston Spa Light and Power Company has plans completed for the installation of arc lights to illuminate the main streets of Ballston Spa.

PASSAIC, N. J.—The council of Passaic has awarded the contract for electric lighting for the coming five years to the Weehawken Construction Company.

YREKA, CAL.—The Siskiyou Electric Light and Power Company, with headquarters at Yreka, has secured control of the Kappler plant at Etna, through lease.

HUNTINGDON, TENN.—W. J. Holman has made a deal with a committee of the municipal board of aldermen whereby he will lease the electric light plant and waterworks.

DENVER, COL.—The Montrose Electric Light and Power Company has completed a two-story brick building sixty by 142 feet at Montrose. New machinery will be installed throughout.

CHARLOTTE, N. C.—The Catawba Power Company has taken over the electric plant of the Highland Park Manufacturing Company, located near the large cotton mills, north of Charlotte.

ALBUQUERQUE, N. M.—A deal has been consummated whereby Gregory Page, of Gallup, takes over the Gallup Electric Light and Power Company. The company has a capital of $50,000.

SHENANDOAH, PA.—The Shenandoah borough council has awarded the contract for lighting the town to the People's Light Company, at a contract price of $63.50 per light per year for three years.

FINDLAY, OHIO—The village council of Ottawa has granted a franchise to the electric light company of Findlay to construct, maintain and operate a heat and power plant for a period of twenty-five years.

QUINCY, ILL.—The controlling interest in the Independent Light and Power Company, of Quincy, has been sold to a Chicago capitalist. The new manager will be N. J. Ferris, of Chicago. The terms have not been made public.

KNOXVILLE, TENN.—At a special meeting of the city council a resolution was passed calling for the framing of a bill for presentation to the legislature asking authority to issue $200,000 worth of bonds with which to construct an electric light plant.

WHEELING, W. VA.—The stockholders of the Moundsville Electrical Company at a meeting held recently reelected the old board of directors, as follows: B. B. McMechen, T. S. Riggs, Fred Kemple, H. W. Thompson, S. M. Steele and J. E. Roberts.

TRENTON, N. J.—Vice-Chancellor Grey has made an order appointing Clifton C. Shinn receiver for the Shore Electric Light, Heat and Power Company. The defendant company has contracts for lighting Pleasantville and Absecon, in Atlantic County.

HARTFORD, KY.—The work of erecting an electric lighting plant at Hartford has been begun. In the city of Hartford 1,000 lights will be utilized. A line will also be run to Beaver Dam and arrangements made to light that town from the Hartford plant.

FLORENCE, COL.—The Arkansas Valley Electric Light Company is planning to change its system of electric lighting to an alternating-current system. Plans are now being draughted and arrangements made to light Rockvale, Coal Creek and Williamsburg.

RAPID CITY, S. D.—Articles of incorporation have been filed for the Black Hills Electric Power and Mining Company. The company will put in a power plant at Silver City that will generate 5,000 horse-power, which is to be sold at $120 per horse-power per year.

GREELEY, COL.—The National Construction Company, of South Bend, Ind., has commenced work on the erection of a $20,000 water and electric light plant for the town of Evans, four miles south of Greeley. The contract calls for completion of the plant within seventy-five days.

HARRISBURG, PA.—Steelton may be lighted by electricity generated at the plant of the York Haven Light, Heat and Power Company. The plan is to bring the electricity to Steelton by a heavy cable stretched across the river at York Haven and thence to the borough along the old canal bed.

CANON CITY, COL.—The Park Center Land and Ditch Company will install an electric plant at a point four miles from Canon City. The plant will light Four Mile, Park Center, Fruitmere and Orchard Park, and will also supply power to operate an electric car line connecting these places with Canon City.

WHEELING, W. VA.—The Benwood & McMechen Electric Light and Heat Company and the McMechen Home Electrical Company have consolidated and the machinery from the latter concern will be moved to the former company's plant. The new company will be known as the Ohio Valley Electric Light and Power Company.

MT. VERNON, OHIO—The Citizens' Electric Company is being formed. The entire bond issue has been taken and construction work will begin as soon as the weather permits. A dam thirty-six feet high and 565 feet long is to be constructed across the river at a point a short distance northwest of Zuck, where the plant will be built.

KNOXVILLE, TENN.—The Knoxville city council has passed resolutions favoring municipal ownership of the electric light plant and has appointed a committee to confer with the light commission and report back to the council the cost. The commission submitted a report some months ago. The contract with the present company expires in July.

BURLINGTON, VT.—A contract has been entered into between the village of Northfield and the firm of Moody & Almon, whereby the village is to be supplied with electric lights. The firm will supply a twenty-four hour service. In order to carry out the contract the firm will have to install a steam plant to be run in connection with its water power on the Mad river.

HONDO, TEX.—Hondo is about to have two electric light plants, both to be put in by local firms. Holloway & Thallman have secured a permit from the commissioners' court to place poles and wires along and across the streets of the town for the purpose of installing a lighting plant, while the Hondo Gin and Milling Company has ordered the necessary machinery and expects to have its plant in operation within the next sixty days.

TROY, N. Y.—Within the next thirty days electric power for all purposes will be in readiness at the plant of the Empire State Power Company, at Schoharie Falls. Early next spring a pole line will be erected from Ballston Spa to a permanent substation near Amsterdam, and a connection will be made with the wires of the Hudson River Water Power Company. E. L. Ashley, of Glens Falls, president of the latter company, controls the Empire State Power Company.

MEMPHIS, TENN.—The Merchants' Power Company has been organized with a capital of $500,000 to install a new lighting plant in Memphis. Those interested in the organization of the new company are all Memphis merchants and bankers, and in addition to the $500,000 of stock, which has all been subscribed, the promoters of the enterprise assert that sufficient additional capital is behind the company to build, equip and operate the plant until it is placed upon a paying basis.

MUSKOGEE, I. T.—The Commercial Club, of Muskogee, has undertaken to harness the falls of the Grand river, ten miles from

Muskogee, that it may utilize them to develop power for Muskogee. An investigation has been made, and it is reported that the plan is entirely feasible. Engineers have been employed to locate definitely the best place for building the large power-house, and as soon as the plans can be completed the Commercial Club will undertake to finance the project.

LOGAN, UTAH—At a regular meeting of the Logan city council Orson Smith, superintendent of the Logan city electric light plant, presented a partial report of the condition of that enterprise. According to the report the city now has 3,750 lights connected up, 500 of them being street lights. Since May 1, 1904, the expenses of operating the plant amounted to $3,749,21, and its earnings amounted to $10,855.35, leaving a profit of $7,106.14. The total cost of installing the plant is given as $99,495.98.

PORTLAND, ME.—The annual meeting of the Consolidated Electric Light Company of Maine was held recently in Portland. The following officers were chosen: president, Leander W. Fobes; vice-president, Charles W. T. Goding; treasurer and general manager, George E. Raymond; board of directors, Leander W. Fobes, Clarence Hale, James English, of New Haven, Charles W. T. Goding, Fred E. Richards, George E. Raymond, Charles R. Milliken, William M. Bradley, Henry P. Cox, Seth L. Larrabee, George F. West.

NORTHVILLE, MICH.—The Northville common council has granted a franchise to C. A. Ward, of Ann Arbor, for furnishing electricity for lighting the streets and residences and power for factories in the town. The franchise is for thirty years, and carries with it a ten-year contract to supply the village and private consumers. The company which Mr. Ward represents will develop electricity near Hamburg on the Huron river, where it will build three large dams. Wires will run to Northville, South Lyon, Ypsilanti, Ann Arbor and other points.

FREEHOLD, N. J.—The Freehold Electric Light, Heat and Power Company plant has been sold at public sale by Richard Stockton, receiver of the concern. The plant was bid in by P. Van Dorn, of Princeton, for $2,100. Mr. Van Dorn represented the Harrisburg Foundry and Machine Works, which was one of the largest creditors of the company. The plant includes five miles of wire, 150 poles, two dynamos, forty-horse-power boiler, 100-horse-power engine, switchboard and fixtures, and the building and land containing the machinery. The sale also includes the franchise to erect poles and string wires in certain streets in Freehold.

BIRMINGHAM, ALA.—The latest water-power-electrical enterprise projected in the South is the Tallapoosa Water Power and Electric Company, articles of incorporation for which are now being prepared. This company purposes to build a $500,000 power plant at Sturdivant, on the Tallapoosa river, four miles from Alexander City, in Tallapoosa County. Birmingham people are organizing the company and eastern capitalists are now corresponding relative to locating manufacturing industries to use the electric power that will be developed. The company's plans include the transmission of the electricity to Birmingham, a distance of about seventy miles.

PERTH AMBOY, N. J.—Alleging that the Public Service Corporation is unduly discriminating against Perth Amboy, a number of local merchants is planning to form an independent electric light company and manufacture current for their own use. Some of those interested in the movement are Peter Floersch, Kelly & McAlinden, Sickles Brothers, Gannon & Sheehy, F. W. Woolworth & Company, L. Briegs and S. M. Jacobsen. It is planned to construct a power-house in the rear of some of the business houses whose owners are in the company. It is claimed that no franchise is needed to string wires from building to building, even when it is necessary to cross streets.

ELECTRICAL SECURITIES.

Apparently there was a revival of interest in the stock market last week, which, while not reaching the proportions of a boom, actually produced three "million-share" days—the first since the beginning of the year. Prices averaged higher, also, and while the advance was irregular it was well maintained. The breaking of the deadlock which has existed in the building trades and the suspension of hostilities in the textile industry indicate that working conditions may be expected to improve. The possibility of an extensive strike on the Pennsylvania system and rumors of a $3,000,000 strike fund among the coal miners have had little unsettling effect. What is particularly disheartening is the shadow which is now cast over all of Russia, with war on the one hand and civic strife on the other.

Excess of exports in December were only $48,722,725, or the smallest in any December since 1895. While the domestic exports decreased $33,598,000, the total exports only decreased $29,532,000. Imports increased $18,796,000 and the excess of exports decreased $48,328,000. The December figures complete the foreign trade record for the year 1904. In this period imports reached a new high record of $1,035,907,000, or an increase of $40,413,000, while exports were $1,451,352,000 or a decrease of $33,401,000. The excess of exports for the year was $415,445,000, or the smallest of any calendar year since 1897.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JANUARY 21.

New York:	*Closing.*
Brooklyn Rapid Transit	62½
Consolidated Gas	198¾
General Electric	187
Interborough Rapid Transit	197½
Kings County Electric	200
Manhattan Elevated	170¼
Metropolitan Street Railway	116
New York & New Jersey Telephone	168
Westinghouse Manufacturing Company	193½

Since January 1 the earnings of the Brooklyn Rapid Transit Company have shown an increase of $5,000 per day. From July 1 to January 7 the earnings of the system have increased $600,000, an average increase of about $100,000 per month.

Kuhn, Loeb & Company have purchased from the Western Union Telegraph Company $3,000,000 of its funding and real estate and mortgage bonds. This is part of an issue of $20,000,000. The bonds will bear 4½ per cent interest.

Boston:	*Closing.*
American Telephone and Telegraph	145
Edison Electric Illuminating	253½
Massachusetts Electric	61
New England Telephone	138
Western Telephone and Telegraph	93½

The directors of the Western Telephone and Telegraph Company have declared a regular semi-annual dividend of 2½ per cent on the preferred stock. The dividend is payable February 1.

The Boston Elevated Railway Company has declared a regular semi-annual dividend of 3 per cent, payable February 15.

The instrument output of the American Telephone and Telegraph Company for the year 1904 was the largest year's output in the history of the Bell telephone system, amounting to 701,047 net. The largest previous output was in 1903—629,197 instruments. The total number of instruments outstanding is now 4,480,564, the growth during 1904 being 18½ per cent. The number of subscribers at the close of the year was approximately 1,800,000.

Philadelphia:	*Closing.*
Electric Company of America	10¾
Electric Storage Battery common	78
Electric Storage Battery preferred	78
Philadelphia Electric	9⅞
Philadelphia Rapid Transit	24⅞
United Gas Improvement	108¾

Chicago:	*Closing.*
Chicago Telephone	138
Chicago Edison Light	167
Metropolitan Elevated preferred	60
National Carbon common	40
National Carbon preferred	112
Union Traction common	11½
Union Traction preferred	45

Chicago Edison directors have declared the regular dividend of 2 per cent on the preferred stock, payable February 1. Books closed January 4, and reopen February 2.

The directors of the National Carbon Company have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable February 15. Books close February 4 and reopen February 16.

ELECTRIC RAILWAYS.

ABERDEEN, S. D.—Farmers living in the vicinity of Leola, in McPherson County, have taken up the project of building an electric line between that town and Aberdeen.

WASHINGTON, PA.—The Donora, Webster & West Newton Street Railway Company is preparing to connect the three towns by trolley. All rights of way have been secured.

PITTSFIELD, MASS.—It is announced that the Pittsfield Street Railway Company is to build during next season a power plant. Its power is at present secured from the Pittsfield Electric Company.

MINERAL WELLS, TEX.—A fifty-year franchise for an electric street railway and power plant has been granted to a party of Dallas capitalists. The franchise calls for the use of about five miles of the principal streets.

HAMILTON, ONTARIO—The Hamilton, Ancaster & Brantford Railway will build an electric railway to Galt and Guelph, branching off from the Hamilton, Ancaster & Brantford Railway on the way from Hamilton at Ancaster village.

BOWLING GREEN, OHIO—The mayor of Bowling Green has signed an ordinance granting a franchise to the Lake Erie, Bowling Green & Napoleon Railway Company to extend its lines to a point seven miles west of Bowling Green by January 1, 1906.

ARKANSAS CITY, KAN.—The right of way for the Kansas-Oklahoma interurban railway through the government's Chilocco reservation has been agreed upon, and the construction of the road will be completed between Arkansas City and the Chilocco schools before other lines are commenced.

SPRINGFIELD, ILL.—Directors of the Springfield, Beardstown & Quincy Railroad Company have arranged with representatives of the United States Construction Company, of New York and Washington, to finance and build an electric road from Springfield by way of Petersburg and Beardstown to Quincy.

PORTLAND, ORE.—The Willamette Valley Electric Railroad Company has started a force of men at work clearing the right of way for the power canal at Martin's Rapids, on the McKenzie river, twenty miles east of Eugene. It is stated that active construction of the trolley lines will begin in the early spring.

READING, PA.—The Kunztown & Fleetwood Street Railway Company has elected the following officers: president, H. E. Ahrens; directors, John R. Miller, George B. Schaeffer, W. D. Mohn, P. L. Diener, F. R. Wagner, S. K. Hoffman, L. T. Custer, James W. Shepp, Richmond L. Jones, W. A. Rosen, John A. Rigg and John M. Frame.

READING, PA.—At a meeting of the Pottstown & Suburban Street Railway Company these officers were elected: president, T. F. Durham; vice-president, George O. Runyeon; secretary, H. W. Snyder; treasurer, C. Q. Guldin; directors, T. F. Durham, George O. Runyeon, H. W. Snyder, John S. Gilbert and I. B. Stoudt.

FREDERICK, MD.—James E. Ingram, Jr., president of the Baltimore & Frederick Electric Railway Company, which has secured an extension of its franchise for the use of the streets of Frederick, states that the road will be completed and in operation by September 5, 1905, the date to which the franchise was extended.

PETERSBURG, W. VA.—The Mineral county court has granted to the Keyser, Burlington & Petersburg Electric Railroad Company the privilege of crossing the county roads and of using certain portion of said roads for the purpose of building and operating an electric railroad. The company is composed of Cumberland (Md.) capitalists.

GRAND RAPIDS, MICH.—Money has been raised for the building and equipment of the road of the Kalamazoo & South Haven Traction Company at a cost of $2,200,000. The road will run from Saugatuck through South Haven to Paw Paw lake; from there the company will run two lines, one to St. Joseph and the other to Kalamazoo. G. E. Bardeen, C. W. Williams and W. S. Dewing hold the franchise.

WELLSVILLE, OHIO—Petitions will be presented to the next council by the United Power Company asking permission to build a street railway to the Jefferson County line. This will give the company a connection with the Steubenville traction lines at Empire, and will give through trolley service from Smiths Ferry to Wheeling, W. Va.

GREENVILLE, PA.—A syndicate is being formed in New York to finance the Shenango Traction Company, which purposes to build a line from New Castle to Meadville by way of Wheatland, Sharon, South Sharon, Sharpsville, Greenville and Conneaut Lake. The promoters expect to make the line a connecting link of a continuous trolley line from Pittsburg to Buffalo.

RICHMOND, IND.—It is understood here that the Columbus, Greensburg & Richmond Traction Company, which purposes to begin construction early next spring, will not enter Richmond, but will make Centerville, which is six miles west of this city, its northern terminal. If this is done the company expects to make tariff arrangements with the Richmond Street & Interurban Company to reach Richmond over its tracks.

GLENWOOD, IOWA—James A. Swope, L. B. Hanson and A. J. Howe comprise the directorate of the proposed Iowa & Nebraska Interurban Electric Transit Company, which will effect the rapid handling of passenger and freight business between Rockport, Mo., and Omaha, the primary terminals. The line will touch Sidney Hamburg, Taber, Glenwood and Malvern, Iowa, crossing the Missouri river at a point opposite Bellevue, Neb. Contracts covering a portion of the right of way have already been let, and the actual work of construction will begin about May 1, 1905.

MONTREAL, CANADA—The Montreal Street Railway Company has decided to spend $500,000 in improving the system during the present year. The plan of improvement includes the erection of three subpower stations at different terminals of the system. Each substation will have 1,000 horse-power, thus enabling the company to put a much larger number of cars on all parts of the system any time during the day. The company has concluded arrangements for the purchase of twenty acres of land north of the car sheds on St. Denis street. This will enable the company to extend its system of sheds when the requirements demand it.

PHILADELPHIA, PA.—The West Chester Traction Company has for the first time in its history made public a statement of earnings. The report is for the year ended November 30 last and shows gross earnings from operations to have been $171,289; operating expenses, $111,257; net earnings, $60,032; other income, $2,794; fixed charges, $38,262. This shows a surplus, minus a small capital reduction, of $24,138. These directors were elected: John Sellers, A. Merritt Taylor, Anthony A. Hirst, S. H. Austin, Jr., William Sellers, C. S. Hinchman, William Taylor, W. C. Alderson, J. R. Wainwright, H. A. Doan, C. C. Tayler, Howard Sellers and P. S. Williams.

LEGAL NOTE.

GENERAL ELECTRIC COMPANY LAMP SUITS—In the two suits brought by the General Electric Company against James McLaren, trading under the name of the Standard Incandescent Lamp Company, in the United States Circuit Court for the District of New Jersey, for infringement of patents No. 537,693 and No. 726,293, decrees for the complainant, granting an injunction and appointing a master for the purpose of taking testimony on an accounting for profits and damages, were filed on January 10, and the injunctions issued and handed to the marshal for service. The two patents involved in these suits are those known to the electrical lamp manufacturers as the "chemical exhaust" patents. In the two suits brought in the United States Circuit Court for the Southern District of New York against the Talmont Electric Engineering Company by the Edison Electric Light Company and the General Electric Company, for infringement of patents No. 444,530 and No. 532,760, final decrees were filed on January 13 and injunctions issued and served upon the defendant. The Talmont Electric Engineering Company has made satisfactory arrangements whereby it is permitted to handle in future lamps licensed under these patents.

PERSONAL MENTION.

MR. H. C. ABELL has been appointed Wrinkle editor for the Denver-Colorado Springs meeting of the National Electric Light Association.

MR. GEORGE R. NEWCOMER has been placed in charge of the Memphis, Tenn., office of the Columbia Incandescent Lamp Company, of St. Louis, Mo.

MR. L. U. FRENCH, of Jefferson, Ohio, took charge, as manager, of the Delaware, Mo., office of the Bell Telephone Company, to succeed Mr. W. A. Reyburn, resigned.

MR. H. J. PETTINGILL, of Boston, vice-president of the Wisconsin Telephone Company, has been elected head of the Bell telephone interests in Minnesota and the two Dakotas.

MR. FRANK M. DUNCAN, formerly chief clerk to Superintendent Deuel, of the Union Pacific, has been appointed manager of the Denver office of the Western Union Telegraph Company.

MR. V. E. RAGGIO has been appointed manager of the new branch office of the Wesco Supply Company, at Fort Worth, Tex. He was formerly traveling salesman in Texas for the company, and later the general sales manager.

MR. RAYMOND W. STEWART, formerly of Camden, has accepted a position as manager of the Greenville Electric Light and Power Company. Mr. Stewart for the past year has been employed by J. N. V. Lane & Company, of Bangor, Me.

MR. MAX LOEWENTHAL, secretary of the Prometheus Electric Company, New York city, has been awarded a medal by the International Jury of Awards of the St. Louis World's Fair for his personal contribution to the art of electric heating.

MR. CHARLES B. GRAVES has accepted a position with an electrical concern in Manila, P. I. Mr. Graves was at one time superintendent of the municipal lighting plant at Marblehead, Mass., and later had charge of installing a large electric plant in Brazil.

DR. P. L. T. HEROULT, one of the pioneers in the application of the electric furnace to the production of metals, has been granted the Chemical Arts gold medal by the Société d'Encouragement pour l'Industrie Nationale, of Paris, for his works on electrometallurgy.

MR. WILLIAM R. KING, M. E., formerly of 39 Cortlandt street, New York city, is now associated with Messrs. Sanderson & Porter, 52 William street, New York city, in their practice as consulting engineers and contractors for the development of railway, light, hydraulic and power propositions.

MR. S. S. NEFF, the general superintendent of the Mexican Electrical Tramways, Mexico City, has, owing to ill health, tendered his resignation and it has been accepted by the company. For the present Mr. Wheatly, general manager of the system, will attend to the business of the general superintendent's office, and the various division superintendents have been instructed to report to him.

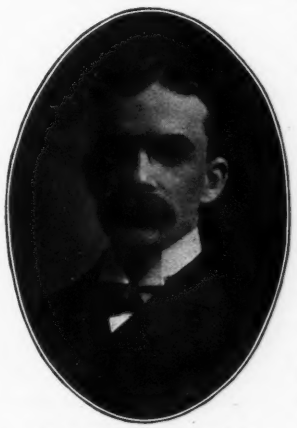
MR. DEAN B. SMALL, manager of the Lawrence, Mass., telephone exchange, has retired from that position. He will assume the position of chief clerk in the executive office of the telephone company in Boston. Mr. Small has held the position of local manager in Lawrence since three years ago last February. He succeeded the late Mr. H. O. Pond. Mr. Small gained his training in the business in the office of the division superintendent at Lowell.

MR. THOMAS A. EDISON was operated on for the removal of a mastoid abscess, on the evening of Monday, January 23, at his home, Glenmont, in Llewellyn Park, West Orange, N. J. Mr. Edison has been suffering for some time from a growth at the base of the skull, near the left ear. Quite recently this became more painful, and it was decided to operate in order to prevent the possible formation of blood poisoning. The operation was considered highly successful by the attending physicians and Mr. Edison pronounced entirely out of danger on Tuesday morning.

PROFESSOR MONROE B. SNYDER, director of the Philadelphia Observatory, announces that he has discovered the existence of radium in the solar photosphere, and of radium emanation in the solar corona, and in the auroral streamers of the earth. He also finds that radium and radium emanation, the latter identical with coronium, are widely and correlatively distributed in stars, nebulæ, and very probably comets. Professor Snyder read his first paper on "Universal Celestial Radioactivity" before the American Philosophical Society Friday evening, January 20.

MR. G. M. GEST, the expert subway contractor of New York and Cincinnati, and a crew of fifteen assistants sailed on the steamer Vigilancia, on Thursday, January 19, bound for Mexico. Mr. Gest has the contract in Mexico City for the building of a subway system through the entire city for the Mexico Light and Power Company. Several carloads of tools have been forwarded by the all-rail route. This is one of the largest contracts Mr. Gest has ever undertaken, but is not the only foreign project in which he is interested, it being his intention to send other crews abroad on work which is now being put in contract form.

DR. W. ELWELL GOLDSBOROUGH, director of the school of electrical engineering, Purdue University, Lafayette, Ind., and during the past three years chief of the department of electricity at the Louisiana Purchase Exposition, has become associated with J. G. White & Company, New York city. Dr. Goldsborough will ultimately be permanently located in New York. For the present, however, his time will be divided between Lafayette and New York city. Incidentally, he is still giving attention to the matter of closing up the affairs of the department of electricity of the Louisiana Purchase Exposition, which will necessitate his being in St. Louis at times during the next month or so. Dr. Goldsborough was graduated from Cornell University in 1892, with the degree of mechanical engineer. During 1892 and 1893 he was electrical engineer for the Colliery Engineering Company, Scranton, Pa. In 1893 and 1894 he was in charge of the department of electrical engineering of Arkansas University, Fayetteville, Ark. He was assistant professor of electrical engineering at Purdue University from 1894 to 1896, and professor of electrical engineering at Purdue from 1896 to 1898. From 1898 to the present time he has been professor of electrical engineering and director of the electrical laboratory at Purdue. In 1894 and 1895 he was consulting engineer of the Edison Electric Illuminating Company of Baltimore, Md., during which time an extensive series of tests on the Pratt street station was carried out, these tests forming the subject of a paper before the American Institute of Electrical Engineers, and comprising a complete report of central station performance. In 1901 Dr. Goldsborough conducted a comprehensive series of tests on the system of the Union Traction Company, of Indiana, reports of which were made the subject of papers before the American Institute of Electrical Engineers. Dr. Goldsborough is a member of the committee on the photometry of arc lamps of the National Electric Light Association. Under the direction of this committee a very comprehensive series of tests on the photometry of arc lamps and various other sources of illumination has been carried out at Purdue University. These tests, issued in four annual reports, are included in the transactions of the association. Dr. Goldsborough is a frequent contributor to the scientific and the technical press, and to the transactions of engineering societies. He is a vice-president of the American Institute of Electrical Engineers, a vice-president of the International Electrical Congress, St. Louis, a member of the Institution of Electrical Engineers, of Great Britain, and a member of the American Electrochemical Society and of the Association for the Promotion of Engineering Education. He was awarded the grand prize by the superior jury of the Louisiana Purchase Exposition for an effective presentation of scientific and commercial development in electricity. He is chairman of the executive committee of the Electric Railway Test Commission, under whose direction an elaborate series of wind-resistance tests is now being conducted at Anderson, Ind. He was recently decorated by the King of Italy with the order of Knight of the Crown.



DR. W. ELWELL GOLDSBOROUGH.

INDUSTRIAL ITEMS.

THE BENJAMIN ELECTRIC MANUFACTURING COMPANY, 42 West Jackson boulevard, Chicago, Ill., and 27 Thames street, New York, will send its new catalogue, B-15, on request. This catalogue describes and illustrates Benjamin wireless clusters and lighting specialties.

THE INDIANA RUBBER AND INSULATED WIRE COMPANY, Jonesboro, Ind., manufacturer of "Paranite" and "Peerless" rubber-covered wires and cables, is distributing a valuable office calendar. The calendar pad is larger than usual, and the numbers are large enough to be seen at a considerable distance.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., in its circular No. 1096 describes and illustrates oil switches and oil circuit-breakers. This circular is replete with interesting data concerning these important devices. A number of forms of oil switches and circuit-breakers are shown, giving a good idea of modern practice in this respect.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., describes and illustrates in bulletin No. 141 S. K. C. polyphase induction motors. Bulletin No. 142 describes and illustrates a line of single-phase induction motors. The bulletin takes up in detail the various types of small induction motors, and gives the reasons for the determination of the design in each group.

THE PROMETHEUS ELECTRIC COMPANY held its annual meeting in the city of New York on Monday, January 9, 1905. The following officers were elected: president, D. T. Davis; vice-president, Dr. S. S. Wheeler; secretary, Max Loewenthal; treasurer, William B. Symmes, Jr.; also the following directors to serve for one year: David T. Davis, Dr. S. S. Wheeler, William B. Symmes, Jr., F. S. Blackall, Max Loewenthal.

THE CONTROLLER COMPANY OF AMERICA, Chicago, Ill., is distributing a series of pamphlets relating to measured telephone service. They are entitled, respectively, "The Stroud System of Measured Service," "Deadheads *versus* Dividends," "Press Opinions on Nickel Service." The company is also sending out a brass check, issued by the Hyde Park Provision Company, which can be used in the measured service instruments in place of a nickel.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Ct., has issued catalogue No. 5, dated January, 1905. This catalogue describes and illustrates the company's electrical specialties, including switches, cutouts, rosettes, combination switches, weatherproof sockets, porcelain base switches, flush receptacles, cord adjusters, pendant switches, switchboards, panelboards, iron service boxes, fuse blocks and panel cutouts.

THE BISHOP GUTTA-PERCHA COMPANY, 420-426 East Twenty-fifth street, New York city, at the stockholders' meeting, January 11, elected the following persons as directors for the ensuing year: Amos A. Browning, Norwich, Ct.; Ellen I. Anderson, Rochester, N. Y.; Henry A. Reed, Newark, N. J.; Harry D. Reed, New York city; W. Boardman Reed, Mount Vernon, N. Y. The usual semi-annual dividend of five per cent on the capital stock was declared. The directors elected for president and treasurer, Henry A. Reed; for vice-president, W. Boardman Reed; and for secretary, Louis F. Reed.

THE BUCKEYE ENGINE COMPANY, Salem, Ohio, has issued a handsome catalogue descriptive and illustrative of the various forms of Buckeye engines. The first sixty pages of this catalogue are given up to illustrations of the various types of engines of every capacity. In addition to views of complete engines there are numerous sketches of details. The second section of the catalogue describes at length the mechanical construction and the performance of simple Buckeye engines. In the third section the characteristics and performances, together with complete descriptive data, of compound engines are given.

THE NEW YORK CENTRAL & HUDSON RIVER RAILROAD COMPANY, through its general passenger agent, Mr. George H. Daniels, is presenting No. 33 of its "Four-Track" series. This booklet is entitled "The Centre of the First City in the World." The booklet is intended to convey to the stranger in New York an idea of what the imperial city is to-day. There has probably never been issued a more complete and accurate presentation of so much information concerning New York city. A double-page map in the centre of the booklet gives the reader a splendid idea of the contour of the city, and is a ready reference for almost any sort of information.

RICHARD TOENNES, box 344, Boonville, Mo., is presenting to electric supply houses and electric light and power companies a new form of heating device called the "Little Giant" electric water heater. This heater can be used on alternating current, from 50 to 220 volts. The manufacturer states that if the apparatus is connected to a 110-volt alternating current of 16,000 alternations, it will boil a pint of water in one minute and use about the same amount of current as four or five sixteen-candle-power lamps. The electric water heater is carefully packed, and the outfit includes an Edison attachment plug, a Thomson-Houston adapter, and one yard of wire.

FRANK B. COOK, 249 West Lake street, Chicago, Ill., has been making some radical improvements in his pole-cable terminals. Mr. Cook states that he has at last evolved what he considers the best cable protection on the market. The type "S. A." terminal is a combination of the tubular line fuse and carbon lightning arrester, mounted upon a galvanized sheet-steel cable box. This is provided with a bracket so that the terminal can be attached either to the cable pole or cross-arm. A sliding galvanized cover protects all connections from the weather. For some time these terminals were made with a heavy cast-iron cable box. The sheet-metal box used at the present time reduces the weight considerably and makes the connections easy of access.

THE CHICAGO FUSE WIRE AND MANUFACTURING COMPANY, Chicago, Ill., announces that Mr. W. R. Goodman, secretary of the company, who has been connected with the business since its beginning sixteen years ago, has established an office at 853 Broadway, corner Fourteenth street, New York city, where he will personally look after the interests of the company in the East. The stock in New York is rapidly being increased to meet the demands of the trade in the following lines: fuse wire and fuse strip, fuse links, regular and special enclosed fuses, telephone fuses and blocks, wire joints and paper insulators, switch outlet boxes, etc. The business in the eastern territory has been making large increases, and a full stock will be carried so that all orders may be filled promptly.

W. N. MATTHEWS & BROTHER, 200 Carleton Building, St. Louis, Mo., manufacturers of Stombaugh guy anchors, are making an offer to telephone, electric light and street railway companies which they state is securing many new customers Wherever a doubt exists as to the holding ability of the Stombaugh guy anchor, the offer is made to screw one of these anchors into the ground alongside of a dead-man. The strain is then taken off the dead-man and put on the anchor in such a manner that if the anchor does not hold, the strain will go back to the dead-man, and no damage will result. If the anchor does not hold it may be returned at the company's expense. Thirty days is the time allowed for testing. The company states that this test almost invariably results in a new customer.

THE WESCO SUPPLY COMPANY, St. Louis, Mo., has established a branch office and warehouse at Fort Worth, Tex., in order to meet the urgent demand of its southwestern trade for a nearer supply depot. The warehouse is located on the Texas & Pacific tracks at 319-321 West Fifteenth street, directly opposite the Texas & Pacific freight house and in close proximity to the Union station. It is the intention of the Wesco Supply Company to carry in stock at Fort Worth everything in the way of electrical equipment and supplies. The initial consignment comprises several carloads of rubber-covered wire in all sizes; also a large stock of weatherproof wire in all sizes, iron wire, strand and porcelain material, arc and incandescent lamps, as well as general electric wiring supplies. The company will also carry in stock, ready for immediate shipment, magneto switchboards, of the smaller capacities, and magneto telephones, which are the product of its telephone factory in St. Louis. Two carloads of "Wesco" alternating and Peerless ceiling and desk fans are included in this stock as well as a full line of motors and dynamos.